THE JOURNAL

OF THE

ROYAL DUBLIN SOCIETY.

NOTICE.

It is to be understood that the Society is not responsible for any opinion or statement of facts in the Essays published in this Volume. The Authors of the several Papers are alone answerable for their contents.

THE JOURNAL

OF THE

ROYAL DUBLIN SOCIETY.

VOL. VII.

DUBLIN:
PRINTED BY ALEX. THOM, 87 & 88, ABBEY-STREET,
PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1878.

NOTICE.

The further publication of the Journal is discontinued; the Papers read at the Scientific Meetings will in future be published in 8vo as "Scientific Proceedings," and the more important ones in 4to as "Scientific Transactions."

No. XLIV.—Vol. VII.] [Price 3s.

THE JOURNAL

OF THE

ROYAL DUBLIN SOCIETY.

CONTENTS.

DUBLIN:

HODGES, FOSTER, AND CO., 104, GRAFTON-STREET,

BOOKSELLERS TO THE ROYAL DUBLIN SOCIETY.

LONDON: SIMPKIN, MARSHALL, AND CO. EDINBURGH: JOHN MENZIES AND CO.

1875.

Dublin: Printed by Alexander Thom, 87 & 88, Abbey-street, for Her Majesty's Stationery Office.

The Society

Royal Dublin Society.

FOUNDED 1731. INCORPORATED 1749.

The Society consists of Members, who, on being proposed and seconded, are elected at the next Meeting by Ballot, previously to which the Fees, as follows, must be lodged with the Treasurer:—

Life Membership, ...	**£21 0 0**
Annual Membership (with £3 3*s*. Entrance Fee), .	**2 2 0**

Annual Subscriptions due on 1st January. Persons in arrear on the 1st April cease to be Members.

Annual Members may at any time become Life Members upon payment of £15 15*s*., £10 10*s*., or £5 5*s*., according to standing.

I.—Meetings of the Society and the Council.

1. *Stated and Ordinary Meetings.*

The Society meets at 3 o'clock, P.M., pursuant to the Charter, on the second Thursday in November, and the first Thursday in March and June.

The Council meets during the Session at Three o'clock on every Thursday not occupied by the Meetings of the Society.

2. *Evening Scientific Meetings.*

Meetings of the Society, for the reading and discussion of Papers on Scientific subjects, are held on the third Monday in each Month during the Session.

Persons desirous to read Communications must submit their Papers to the Committee a week, at least, previously, for examination and approval.

The Copyright of all Papers read becomes the property of the Society; and such as are considered suitable for the purpose will be published in the Journal of the Society.

Except under special circumstances, no person can be permitted to occupy the Meeting in reading a Paper for a longer period than half-an-hour; and the Society will not be held responsible for any opinions advocated in the communications read.

Each Subscriber of 5*s*. to the Refreshment Fund is entitled to Tickets, to admit Visitors, at 6*d*. each; or to twelve for 5*s*., available for any of the ordinary Meetings throughout the Session.

The Standing Committees.

Six Standing Committees are annually elected, as follows:—1. Agriculture; 2. Botany; 3. Fine Arts; 4. Library; 5, Natural History; 6. Science.

[*For continuation, see page 3 of cover.*

THE JOURNAL

OF THE

ROYAL DUBLIN SOCIETY.

I.—*On Sanitary Science in Ireland.* A Lecture by WILLIAM STOKES, M.D., D.C.L., F.R.S., Regius Professor of Physic, University of Dublin.

LADIES and GENTLEMEN,—I have to crave your indulgence for the many shortcomings that must appear in this lecture, and I trust you will remember the comprehensive nature of the subject, and understand that it is impossible to give more than a chalk outline of it, bringing into relief such points as relate especially to the health of this city.

Sanitary science, which embraces everything that can prevent disease, and so promote the public health, has long occupied the minds of thinking men in other countries, and now in Ireland the question is asked, what is the meaning of the term, so familiar a one in England, on the Continent, and in America? Some of our fellow-citizens, lay and professional, have established a Sanitary Association in this city, and the Science Committee of the Royal Dublin Society, acting in concert with the Association, have resolved that lectures upon the subject should be delivered in this theatre. This augurs well for the future. I may say that these lectures will not be for the purpose of announcing any novel doctrine. Their object will be to draw the attention of our fellow-citizens to the nature, the great importance, and the extent of the subject.

In this attempt, which is not the first of the kind in Dublin, we feel ourselves at a disadvantage. The subject is a prosaic one, and the public mind has too long been travelling in another direction to remember that Ireland has been frequently the source of epidemic disease, and too long heedless of that sanitary reform which has grown all round her, and the adoption of which is so important to the material

prosperity of the country. In relation to our subject we have nothing to stimulate popular excitement. We have no subjects for oratory, even if we had the power to use it. But we are here to tell you that which we know, and which must be known and thought upon, and to bid the victims of misery, physical degradation, and the unsparing pestilence, plead for themselves—

> "Show you dead Cæsar's wounds,
> Poor, poor dumb mouths,
> And bid them speak for me."

As regards public sanitation, our English brethren are far ahead of us; not very long since they were in much the same condition as ourselves, and had to combat ignorance, and its offspring, ridicule. But in England that stage of the question has been passed, and we may be satisfied that by patience, diligence, the exercise of sound judgment, and the eschewing of theory, we may promote the cause in this country. It is many years ago since Dr. Rumsey, of Cheltenham, at a private meeting of friends, gave the first impulse to a movement which is now everywhere felt in England, and has attained such large proportions that a Royal Sanitary Commission was appointed to examine into the public health, and also to investigate the state of the sanitary law. On the report of the Commission important Acts of Parliament have been introduced by the Government, and the great step taken of the creation and appointment of a Minister of Health —a central authority for regulating and controlling all the laws relating to the physical well-being of the community. A moment's thought will show the great magnitude of the subject. The sanitary laws on the statute-book were multifarious, often anomalous, or even contradictory. Consolidation and revision were necessary to form a comprehensive and intelligible sanitary code, the provisions of which it is hoped will be in accordance with the actual state of science, and the social condition of the people. It gives me pride to say that, indirectly at all events, and in one respect directly, Dublin has borne its share in the good work. It was at the annual meeting of the British Medical Association, held, on the invitation of the heads of the University, in Trinity College in 1867, that it was resolved to petition for the appointment of the Royal Commission of Inquiry. In this the Social Science Congress joined, and shortly afterwards a qualification of a high order in State or Preventive Medicine was established by the Board of Trinity College, the only one of the kind as yet existing in these countries.

Now let us specify some of the subjects with which sanitary legislation must deal. Before enumerating them we may glance at two great points which should guide or influence a Minister of Health. These are indicated by Dr. Rumsey. The first is the creation of a fitting machinery for investigation, and the second the preserving a congruity in the various laws that from time to time may be enacted—congruous they certainly should be, as they are to subserve a common purpose and be worked by a central authority. But whether we can hope for such a complete and comprehensive project as that which Dr. Rumsey has shadowed forth, wherein, to use his words, "each part shall at once and harmoniously fit together like the details of some vast pile which, when completed, would exhibit a unity of design and stand in simple grandeur," is a question. We must not forget that our actual knowledge is still imperfect, science being ever progressive and ahead of us. The subject of public sanitation, which implies Preventive Medicine in its widest sense as distinguished from Curative Medicine, touches every hearth and home in the country; every man, woman, or child from the highest to the lowest; every institution in the State, its power, its defences, its education, its manufactures; every trade, every occupation, domestic purity, domestic happiness, national prosperity, national health, longevity, and morals; the duties of property, the exercise of charity, and the blossoming and the fruit of our common Christianity. Its end is to improve and to preserve man's body in the best condition, and through it his immortal part. "The body of man," says Dr. Acland, "is not only the casket which contains the soul. It is more—it is a casket which, under certain conditions, moulds and modifies the soul." He says again, "There is a class of persons, I am happy to say rapidly diminishing in number, who seem to be of opinion that we who are engaged in sanitary work are somewhat fanatical; and that because it is connected with our material frame, it is therefore a second-rate subject, fit only for inferior men." Further on he says, "If I can read anything in the history of the globe it is this—that the great qualities of a people depend in large measure (except in rare instances) upon the physique of the nation. I appeal to all—that is, those who have studied the philosophy of history—whether it is not the fact that some of the highest of human qualities have been shown in a most eminent degree in days when there was a noble physique, but when there was no systematic education, according to the modern notion of book learning." He adds, "that so far as the comparative national health is

concerned, I say there is no possibility of exaggerating the importance, not to our own country alone, but to the world, of fostering and caring for the body of man."

There are so many important subjects relating to State Medicine, that the first requirement in establishing that machinery for investigation is the education of a class of men able to judge and report on all questions relating to public health. I do not like the term "expert," which implies excellence in but one or two subjects. But State Medicine has a wide scope, and the adviser in it must, for purposes of Government, have proportional powers. Public experts in certain departments there must be, but the adviser as to public health should have a natural aptitude for the subject. He must be highly and generally educated. He must know all the conditions under which the health, vigour, and life of man are best preserved. It is well that he should know the main facts of Curative, as contrasted with Preventive Medicine; be familiar with vital and sanitary statistics, and, by analysing and classifying the results, be enabled to draw just conclusions from them. Such a class of men is now being formed, and the community will demand that the knowledge which they profess will have to be represented in every governing body in the country which has to deal with the physical well-being of the population, from the Imperial Government to every local administration. The status and the rewards of such a class will be measured by the importance of their duties.

Upon the registration of causes of death the public mind is in need of some enlightenment. It requires to be shown that to determine the cause of death is often one of the most difficult of problems. In most cases the discovery after death of an anatomical change is held to account for the death—so it appears on the registry. But such a conclusion may be, and too often is, utterly erroneous. As a natural organic structure throws but little light upon life, so may it be said that diseased structure fails, except in a very few cases, to explain death. In the so-called zymotic diseases the anatomist can say only what they are not. Every day the mistake is made of confounding the effect with the cause. Men die with local disease, but not necessarily of it, and it may be held that in a vast proportion of the deaths of the eight hundred millions of the world, the immediate cause of death remains hidden from us.

In reference to the important question of the registration of sickness, it is plain that there is abundant opportunity for doing it, if not perfectly, at least effectively, by the State

registration of sickness in every institution supported by public funds. Dr. Rumsey observes, "that there are literally no published records of the cases of sickness attended at the cost of the community. The sanitary state of the people is therefore inferred solely from the number of deaths—that is, from only one of the results of sickness—no public account being taken of the number and duration of the attacks which shorten the effective lifetime of the population." "Facts are accumulating to prove that the mere number of deaths occurring in any locality bears no constant or even approximate ratio to the real amount of unhealthiness existing there. As a necessary result of improvements in domestic management and medical treatment, and owing to the removal or absence of those more virulent agents of destruction which prematurely sever the threads of life, its duration has been lengthened in our great cities, but at the same time the sickly and infirm period of existence has been prolonged probably in a greater degree than even life itself. Chronic diseases, or, at least, functional disorders, have increased, vital force is lowered, man's work is arrested, his duties are unperformed, his objects fail, though he still lives. Weakly, diseased children are now mercifully helped, as they never were in olden time, to grow up into weakly, ailing adults, whose children inherit their unsoundness. Is this true sanitary progress? Does it deserve the ostentatious parade of a decreasing death-rate?" Lastly, personal antecedents and remote causes of death now generally escape notice. Dr. Rumsey further shows "that the deaths of those who enter a district merely to die there belong rightfully to another locality. This applies to large towns, seaports, hospitals, workhouses, and so on. The mere death-rate, therefore, as a measure of local unhealthiness, leads to most fallacious conclusions." While I agree with Dr. Rumsey in these statements I am far from denying that an accurate knowledge of the death-rate is of the greatest importance, especially in the absence of trustworthy statistics of disease.

To those who have not thought upon the subject I may read a list of details which must pass under the control of the Minister of Health. It is given in an address to the Social Science Congress, by Dr. Acland, and as the speaker observed that the list is not intended to be exhaustive, I may add a few particulars to it. I shall have to bespeak your patience, but I know that I address an enlightened audience that will bear with me. The first subject is that of water supply; 2nd, removal of refuse; 3rd, control

of buildings, new and old; 4th, sewage; 5th, drainage; 6th, prevention of over-crowding; 7th, prevention of contagious and infectious diseases; 8th, prevention of epidemics; 9th, formation of sanitary areas; 10th, registration of births, and of causes of death; 11th, registration of sickness, as distinguished from death; 12th, the laws of quarantine; 13th, the superintendence of epizootic epidemics; 14th, the inspection of all hospitals, including those of the insane; 15th, the sanitary inspection of penitentiaries and prisons; 16th, the inspection of dispensaries; 17th, the inspection of druggists' establishments; 18th, the inspection of factories; 19th, the inspection of the dwellings of agricultural labourers; 20th, the placing of every district within reach of a sanitary inspection by the best scientific and medical experts; 21st, education and registration of medical practitioners; 22nd, education and registration of nurses and midwives; 24th, control of intoxicating liquors; 25th, mode of obtaining analysis of air, food, water, &c.; 26th, vaccination; 27th, coroners; 28th, vested rights of mill owners and others to interfere with sanitary measures in new populations; 29th, organization of charities.

You may ask why the organization of charities appears in this list. The answer is, because the great national charity is the Poor-law, and destitution so affects the public health that the Minister of Health must necessarily be the Minister of the Poor-laws also. The famine fever of 1847 terribly exemplified how weighty is the connexion between wide-spread destitution and national disease. In that time of panic, error, and confusion, the poorhouses of Ireland became the great foci of disease, owing to their overcrowding, the evils of which were increased by the congregating of masses of people at public works, from a mistaken politico-economical theory, and also at depôts for the distribution of food. To these circumstances mainly Dr. Graves attributes the spread of fever in 1847. In the report of the Poor Law Commissioners, it appears that the total number of deaths in the workhouses of Ireland in the week ending the 14th of April, 1846, amounted to 149. The total number in the corresponding week in 1847 was 2,706. In April, 1846, the inmates reckoned 50,861. In April, 1847, it was 106,888. The numbers in the union fever hospitals increased in the one year from 864 to 8,931. In April, 1846, the weekly rate of mortality in the poorhouses of Ireland was one in every thousand inmates. Take the city of Cork, where, as in other places, the horrible system of overcrowding prevailed. From December, 1846, to April, 1847,

2,130 persons died in the buildings comprising the union workhouse. In it the inmates were put three, four, and five in a bed, and in the convalescent ward there were 44 beds for 125 persons.

The deaths in	January reckoned	329
,,	February	606
,,	March	672
,,	April	523

Two thousand one hundred and thirty deaths in four months in one over-crowded union workhouse! Similar circumstances occurred in the report of the Census Commissioners for 1851. The deaths in the workhouses, auxiliary workhouses, and workhouse hospitals during the year 1847, as returned by the masters and medical attendants, amounted to 66,890. The general total for the ten years of 1841 and 1851 was 283,765—a number which yet does not represent the total mortality in the workhouses during the ten years, but which gives an annual workhouse mortality during that period of more than 28,000. Can any argument be stronger than this to show the connexion between destitution and disease; any evidence more overwhelming and appalling to prove the want of an enlightened medical police, and to show that the public health must be one of the chief cares of the State? Had there been fundamental laws, as indicated by the author I have quoted, enacted on the true principle of sanitary legislation to help the people to do, not that which they can do, but what they cannot—ascertaining what hindrances there were in the way of the people's health, and removing those which they could not remove for themselves, this country would not have been stained with such fearful results of mal-administration and of ignorance of all the sanitary laws.

Cases of famine-collapse from the country occurred in Dublin. These people had all a strange similitude in feature and expression. Passive and uncomplaining, they seemed to wish only for rest and warmth—they asked for neither food nor drink, but waited for death, silent and cold, and their bodies exhaling an odour as of the tomb. The first impulse was to give them nourishment and stimulants freely, but it was soon found that such a course was rapidly fatal, while all those who were fed like infants for days, and recovered from the collapse, became the subjects of the most rapid and malignant typhus.

But there is another matter relating to this epidemic as showing the necessity of a more severe State control. Emi-

gration then received a new impulse, and the people fled from their native shores in tens of thousands, as if a curse had fallen on the land. The overcrowding of the emigrant ships was frightful, and followed by the inevitable result—malignant typhus. In 1847 the number of emigrants to America was double that in 1846, and the ships were not only crowded, but packed with passengers. In almost all, as in the workhouses, typhus, engendered by overcrowding, broke out on the passage. The number of emigrants flying from disease on the land to meet it on the water was in that year at the lowest computation 74,539, and the mortality was greater than on shore. Of these, 5,293 died on the passage, 8,000 reached America in fever; and if the numbers of those who died at sea be added to the deaths in the quarantine hospitals, there is a total of 9,786 deaths. Could the land and the sea give up their dead, what a history would be revealed of ignorance, mal-administration, suffering, despair, and wholesale slaughter in the nineteenth century?

The subject of Preventive as compared with Curative Medicine is to a great extent a modern one. The latter is at least as old as the Egyptian dynasty, and the archaic times of Greece, and has received in modern times a great development. But as regards its effect on the early mortality of certain epidemics, it can hardly be said that as yet Curative Medicine has greatly increased the proportion of recoveries. It is true that in a large majority of cases it has been used at a disadvantage, or it has not been employed at all. But we may point to Preventive Medicine as a development of it. The progress of the physical sciences in modern times, the introduction of their study into university education, and their co-option into medical curricula have influenced the minds of professional men.

Disease has been studied as a part of Natural History, and we have risen from contemplating its effects to researches as to its causes. Though medicine does not rank among the exact sciences, the influences that affect man, in health and sickness, have been investigated with the accuracy used in physical studies. All his relations to air, soil, water, food; all the conditions which influence him in connexion with heat, light, moisture, electricity, have been studied and compared, while the power of statistics has been applied to the laws which influence his birth, development, inheritance of disease, strength, and longevity; also the influence of occupation, the state of civilization, the social and moral standard of population, and the deathrate in different countries and places, as compared with that of birthrate.

If a comparison be made as to the relative value of these branches of medicine to the world, I believe it will be seen that Preventive has, or will have, a larger influence for good than Curative Medicine. And you must not forget that the Preventive will act in lessening the necessity of the Curative Medicine.

Preventive Medicine may be looked at from many points of view, but for our present purpose two may suffice—one, the removing the supposed causes of diseases, whether affecting the individual or giving rise to endemics, or epidemics; and the other, those measures which are to promote the physical well-being of the community. A comprehensive sanitary law should embrace both these objects. Here it is right to say that for many years after the commencement of the sanitary movement in England, many of the measures adopted were at the best of very doubtful utility, especially as regards the prevention and extinction of epidemic disease. In fact, many modern sanitarians with but a smattering of knowledge, and with imperfect powers of reasoning, have done much to throw ridicule upon a great subject. But this was to be expected. In every department of human knowledge there have been, and still are, camp followers of science more ready to theorize than to investigate, whose dogmatism is only equalled by their ignorance, and who have adopted some special line of investigation without any previous training or discipline of the mind. These men, in the words of Curran, "hop with airy and fantastic levity over fact and argument, and perch on assertion which they call conclusion." They have too often acted as if the causes of endemic and epidemic diseases were few, easily understood and definitively settled. When cholera first reached London, appearing in a convict ship at Woolwich, it was attributed to a sewer which emptied itself into the Thames just opposite to the stern of the vessel, and immediately that war against sewers, conveniences which unfortunately we cannot do without, received a great impulse, and has continued for nearly half a century. Sewers, streams, rivers, and damp localities, collections of refuse, not alone of putrefying animal or vegetable matters, but of materials in no way offensive have been in turn accused as having been manufactories of disease, not of cholera alone, but in an enterprising mercantile spirit in a great variety, so as to suit the market. Scarlatina, measles, fever, smallpox, have been supposed to be thus generated.

The tendency to attribute complex phenomena to a single cause is rarely seen in right-thinking men. In a

lecture on State Medicine which I last year had the honour of delivering before the University of Dublin, I quoted these words of a very learned man. In speaking of epidemics he says:—"The supposition of a single cause is quite unsupported by nature—every animal, every plant, every rock, requires for its production the co-operation of many causes, and probably of many we have not yet discovered. All nature depends ultimately on a single cause, but it has pleased that Almighty Cause that the effects which concern us immediately should arise from the co-operation of several of His creatures."

Now, to put the matter in a simple way, the favourite doctrine was, that disease, endemic or epidemic, proceeds from a cause which is preventable—namely, dirt, foul water, foul air, foul dwellings, foul habits, and unwholesome food. And so the question may be asked, what is dirt? Is it confined to race, latitude, or climate? Does it always produce similar effects, or is it capable at one time of causing plague, at another cholera, or fever, smallpox, or scarlatina? Is it always detectable by the eye, or even the nose? and are there conditions in which it is nearly, if not altogether innocuous? Is it an entity, capable of analysis? are there conditions in which it is not preventable? or is its final cause the furnishing to certain minds a ready explanation of that which is truly inexplicable? There is no proof that dirt, in the common acceptance of the term, ever by itself gave rise to a single specific disease. If people live in fresh air, and are not overcrowded, have pure water to drink, and are not in destitution, dirt does not necessarily make them sick. Neither, under the same circumstances, are bad smells, especially if the people are used to them, necessarily excitants of disease. I recommend some of our exclusively detergent sanitarians to visit the north of Ireland at the season of flax steeping, when they may inhale a wide-spread odour which some hold as the *facile princeps* of bad smells. Yet no consequent annual pestilences ravage that prosperous country. Our own Liffey, when the weather is warm and the tide low, is apt to exhale a remarkable perfume, yet Dr. Grimshaw's fever map of Dublin shows that the quays are not the habitats of fever. Remember, the inhabitants enjoy an abundant ventilation, there is no over-crowding, and little, if any, destitution. I have heard a gentleman who for many years lived on Upper Ormond-quay, and the oldest practitioner in Dublin, say that nothing was more remarkable than the longevity of the inhabitants.

It is important to know that there are some antagonistic in-

fluences to the evil effects of dirt, and also that, taken by itself, it is not the cause or source of epidemic disease. Speaking of the condition of the farm-houses and steadings of a district in Ireland, Dr. Pratt observes, that if dirt alone was the common generator of fever the country would long since have been desolated from sea to sea. Yet in his district in the north of Ireland fever is almost unknown. In a town in the south of Ireland a careful survey gave these results. In one part of it, measuring twenty-five acres, resided 700 families, including 4,000 persons. Every house had its dungpit, averaging ten cubic yards in extent, so that in the twenty-five acres there were at least 7,000 cubic yards of decomposing matter. The lower rooms of some of the houses were packed with manure, heated and steaming, yet this town has always been a healthy place, much freer from fever than any other town in Munster; and the question arises, can such a condition give different results in different places, or at different times? Ireland has been from time to time afflicted with epidemics of fever, but the recurrence of such is irregular and inconstant, while their supposed causes are too constant, not alone in towns, but in the isolated dwellings in country districts. Why should these remain long free from fever while the exciting cause, if it be so, is constant? Or again, why should the character in each epidemic be peculiar, while the exciting cause remains the same? "I cannot give my assent," says Dr. Graves, "to the benefits that are supposed to accrue from opening the sewers and whitewashing the houses in the poorer parts of cities. It is true that obstructed sewers give rise to disgusting nuisances, and soiled exteriors are offensive to the eye. But the causes of epidemic disease escape the scrutiny of both nostrils and vision, as is proved by the fact that the worst parts of most capitals of Europe, however abounding in all sorts of abominations, do not give rise to either typhus fever, plague, or cholera. Filth is the outward and visible sign of poverty, and, like poverty, is itself an evil; it oftener accompanies than causes disease; otherwise, as I have said, every capital in Europe would contain within its precincts many self-supporting manufactories of pestilence. I have always been of opinion that poverty is more injurious to health than dirt; that its prevalence entails disease—sporadic disease — from many obvious causes, and increases its spread."

In speaking of the attempt to keep the cholera out of Dublin by enforced cleanliness, for which the Sanitary Committee obtained power to levy a cess, Dr. Graves says,

referring to a certain parish—"If such tax be levied only off the rich, it will amount to almost nothing; if it is to be wrung from the limited resources of the thousand pauper roomkeepers who inhabit that quarter of the city, then, indeed, will they have reason to curse the day that the means for purchasing food were diminished by contributions intended to remove nuisances, and in vain would they be told that they must pinch their stomachs for the general purposes of cleanliness. The Sanitary Committee may, by the force of perseverance and of the law, effect many of the objects they have in view; but I fear, even if they entirely succeed, they will have but converted the wretched dwellings of the miserable inhabitants into whited sepulchres—the abodes of contagious maladies, on account of the entassement or crowded state in which the poor necessarily live. If humanity strives, therefore, in its visits to the haunts of misery to prevent the spread of contagion, it must pluck the inmates from within those bounds, distribute them over a large space, where the same number that now inhabit rooms may occupy large houses, and may have the use of nutritious food; but, alas! this, the only true method of relief, will require something more expensive than the broom and the brush, and those who are so loud in recommending open sewers and whitewashing as sovereign prophylactics will perhaps shrink from contributing their share of that poor-rate or money for relief, which alone can snatch the pauper population from the hands of the destroyer."

These weighty words must not be forgotten. The real antagonistics to any successful Preventive Medicine are poverty and destitution, with their long train of evils—ignorance, apathy, insufficient and improper food, filthy habits, overcrowding, bad ventilation, insufficient clothing, the living in ruined and neglected tenements, the destruction of proper pride and the blessed influence of home. This is the history of cities in which the wealthier inhabitants gradually forsake the older quarters of the town, which, in their turn, become ruinous, and of course the homes of misery and disease.

When we hear a certain class of sanitarians speaking of Preventive Medicine, some might suppose that the origin of epidemic diseases, which we have the authority of Humboldt for saying is one of the most difficult problems in the world, had been solved. But it is not so, and all measures based on such an assumption are of more than doubtful application. The actual origin of specific diseases remains undiscovered. The origin of the plague, yellow fever, typhus, smallpox,

scarlatina, influenza, is not determined. Nothing is known as to the essence or chemical composition of the virus, nor how one poison differs in offence from another, nor whether the difference is a physical or a vital one, a difference involving qualities which cannot be weighed or measured, or analysed. Little is known as to why it is that one individual will resist contagion and another not. Here the anatomist is at fault. Nothing is known as to why in a single family, exposed to the same exciting causes, there shall be a variety of fever, nor why in the relapse cases the type may be very different from that of the first illness. Of the diseases themselves our knowledge is but a negative one, telling us not what they are, but what they are not.

Fortunately practical sanitation can go on though these obscure questions remain unsettled. Though as yet we know little, if anything, of the essence of epidemic diseases, or why they arise, spread for a season, and then spontaneously subside, we do know that their malignity, their contagiousness, their spreading, and their mortality are increased, sometimes to a frightful extent, by all things that depress the vigour of a population—in a word, by those influences against which sanitary reform has to contend. The list of causes, independent of epidemic disease, which damage the general health of the community, is a long one. The parent of many others is destitution, with its consequences. But to prevent destitution in masses of men, and to promote their prosperity, is the province of the social rather than of the sanitary reformer, who has to deal chiefly with the effects rather than with the causes of destitution, though it is certain that disease and destitution may be and often are reciprocally cause and effect. The origin of specific acute disease being undetermined, it follows that a direct action of Preventive Medicine will be in regard to contagion, by exclusion, if possible, and if we fail in that, by diminishing the number of foci of contagion—that is, by separation of the sick from the healthy. Now, this branch of Preventive Medicine seems applicable to most epidemics, for they all appear to spread by contagion. Observe, I do not advocate any exclusive doctrine as to contagion being the sole cause of the spread of epidemics, but that it is a cause—a very important one—is clearly true. Since I was a student, the admission of contagion as a principal cause of the spreading of epidemics is remarkable, and it now seems more than probable that a vast number of acute essential diseases, that is every acute disease that affects the entire system, may be contagious,

Dr. Graves, in his masterly "History of Cholera," has established its spread in Europe by contagion. Professor Haughton has done the same with respect to its ravages in this country; both authors showing that the disease follows the lines of human intercourse. Of late years even typhoid fever, which was held to be non-contagious, is now looked on in a different light by British authors. The observations of Dr. Flint, of America, upon this point are quite convincing. He gives an example of an outbreak of typhoid in North Boston, where the disease was previously unknown. Its importation was due to a single case; and such were the facts that we must adopt his conclusion, that if the disease was not transported and diffused by contagion, it is necessary to admit a series of coincidences almost incredible. The circumstances embrace every important condition for a fair experiment to test the contagiousness of a disease. Had they been deliberately selected and arranged for a scientific object, they could hardly have been rendered more complete or judicious.

In estimating the effects of preventive measures with regard to fever, in the generic sense of the word, we are never to forget that, whether we look at the individual case or at the entire epidemic, it is under the law of periodicity. How many great epidemics have sprung up, we know not how, in the history of the world, ran their destroying course, and then, spontaneously went out before sanitary reform was thought of; and therefore, in the present day to attribute their cessation solely to any special proceeding is inconsistent with sound reasoning. It may yet happen—and God forbid that its possibility should be denied—that science will discover the essence of these affections, and with that, the means of preventing and extinguishing them. When that is accomplished, Preventive Medicine will be employed directly, as it is now indirectly.

Till that time comes, however, there is a great work for us to do. We have on the one hand to labour patiently, and in a severely inductive spirit, in the study of the natural history of epidemics, and their comparison in various portions of the world, avoiding conjecture, and honestly accumulating and analysing facts, which thus treated will in time crystallize into discovery.

The term "preventable disease" has been long in the mouths of a certain class of sanitarians. I do not object to these sanitarians. I wish we had more of them among us, and I wish that every citizen and magistrate, from the Lord Mayor down, was a sanitarian. Prevention of disease

is to be looked on as involving questions of the causes of specific malady, and also of the modes of mitigating its effects. If, on the one hand, a city is threatened with a contagious epidemic, the example of Copenhagen in 1866 shows that it may be virtually saved from its entrance, while, on the other hand, Preventive Medicine may put a stop to epidemic disease.

In his paper on Comparative National Health, Dr. Acland, speaking of the Indian cholera, says:—"A true and scientific man is always hopeful, is ever ready to pursue a work to the end of his life without attained rewards, and to help younger men in collecting facts and drawing safe and sound conclusions, though he himself may never live to know them." We have, on the other hand, dealing with that which is ascertained, to labour for the physical good of the community, and to strive to keep it in the best condition, so as not only to ensure its health, happiness, and prosperity, but also its power to resist disease, whether it be the pestilence that walketh by night, the epidemic disease which is generally preventable, or the effects of chronic or hereditary ills.

Let me not be misunderstood as slighting or decrying public cleanliness, the importance of which to public health requires no new advocacy. I only seek to show that the want of it is but one out of many causes of general injury to the well-being of the community. The existing state of our city, at least in its older and more decayed portions, is simply deplorable. The inhabitants are too ignorant to abate nuisances, and too poor to get rid of them, though they suffer from them. They are helpless, and exemplify that principle of fundamental law that sanitary legislation should aim at helping, not those who can help themselves but those who cannot.

That the vital condition of the population of Dublin is greatly below par I can state safely on the authority of the Registrar-General for Ireland.* There is no surer test, perhaps, of the prosperity and physical health of a population than the height of the birth-rate in that population. And yet what do we find in the case of Dublin? That its birth-rate in the last eight years (I have left the year 1864 out of consideration, for it was the first year of registration in Ireland, and the returns are, therefore, in all probability below the truth)—its birth-rate, I say, exceeds its death-rate by only one per thousand of the population annually. The excess of the birth-rate over the death-rate during the same eight years has been in Edinburgh 8¾; in Glasgow 10¼; and in London 11¼ per thousand of the population annually, against 1 in Dublin. For every 100 persons who died in

* *Vide* Appendix.

Edinburgh during those eight years, 132 children were born; in Glasgow, 133; and in London, 147. But in Dublin for every 100 deaths there were only 104 births. Again, taking into consideration the relative densities of the population—an all-important factor—we find the death-rate of Dublin to contrast unfavourably with that of the cities I have mentioned. It was during the eight years 1865–72, on the average 26·28 per thousand of the population annually, while in Edinburgh it was 27·25; in Glasgow, 30·88; and in London only 24. Now, at the middle of the period of eight years I have chosen for analysis, there lived on every acre in Edinburgh 40 persons; in Glasgow, 89 persons; in London, 40 persons; and in Dublin only 33 persons. For every 100 persons who lived on an acre in Dublin, 121 persons lived on an acre in London and Edinburgh, and no less than 273 in Glasgow. With this sparseness of population, the death-rate of Dublin should be much less than that in London and Edinburgh, and very much less than that in Glasgow, all other things being equal. In actual fact, however, London has a considerably lower death-rate than Dublin. Edinburgh, which is admittedly most unhealthy, but little exceeds the death-rate of Dublin, and Glasgow has a death-rate of only 4 per thousand above that of Dublin.

It is estimated that there are in Dublin *not less than a thousand houses unfit for human beings to live in.* I believe that this estimate is far below the mark. The reports of our nuisance inspectors remind me of early days spent in visiting the poor in the Liberties of Dublin, since which time decay and destitution have been doing their work fourfold in all the poorer parts of our city. The marks of physical degradation in the inhabitants are sickening to look at. The ill-developed frame, the pallid and hollow cheek, the sunken eye, all tell of a population through which endemic and epidemic disease run riot.

Destitution commonly implies over-crowding, filthy habits, bad ventilation, and impure water; and, putting aside the question of the generation of specific disease, it entails many evils affecting the vigour of the body, its development, and its power of resisting acute and chronic disease. It affects the mortality of children to an extraordinary degree with the influence of hereditary taint, and depresses the entire moral and physical condition of the people. I have dwelt on these topics thus far, although they involve abstract questions; but, to come to practical matters, there is one great exciting cause among many of injury to public health. I allude to that constant result of poverty—overcrowding.

The poison thus produced is energetic in proportion to the density of the population. "Are we then," asks Dr. Rumsey, "to stop at the palliative stage of sanitary progress? Can no advance be made in the absolutely preventive direction; can nothing more be done than is now doing, so imperfectly, to remove the obviously prime cause of the evil—the heaping together vast crowds of human beings in confined areas?"

It has been shown by Dr. Farre that the mortality of town districts is much greater than that of country districts. In Liverpool, in 1851, the population was 116 persons to one acre, giving 41·7 square yards to each person, but certain wards were very differently circumstanced. In one there were but nine square yards for each person, and in one street, with fourteen hundred inhabitants, the area was but four square yards for each. Typhus fever attacked the inhabitants constantly, and in the worst localities the number of cases amounted to ten per cent. The mortality was in general from thirty-three to forty-two per thousand, while the death-rate in other wards was but from twenty-four to thirty-two per thousand. In five wards in Nottingham the average space for each inhabitant was from eight and a half to eleven and a half square yards, and not only was the death-rate precisely in the order of the density of the population, but the mean age at death decreased from twenty-three to eighteen years in the same order, illustrating, as Dr. Rumsey remarks, the effect of density upon the vital force of the population, with which, as I have striven to show, sanitary reform has most to do.

It would be of great importance if the sanitary inspection of infected houses should determine even by approximation the number of inmates in such dwellings. In Dr. Whitelaw's survey a house containing eight rooms which was situated in Ardee-street, was reported as containing ninety-five inhabitants, that is nearly twelve for each room; and I know a gentleman who visited that very house in 1870, and found sixteen human beings living in one wretched room.

There is little, if any, evidence to show that the so-called specific diseases are generated by other causes than contagion. This applies to measles, scarlatina, diphtheria, smallpox, and I believe cholera. Of the exciting causes of typhus and of typhoid, something more is known, though of the actual nature of the virus in these diseases we are in utter ignorance. We know, however, that in common with other essential diseases their mortality varies with the epidemic character and the previous physical condition of the sufferer. They are correlative, and under certain states

of the system, very probably even convertible. Therefore, in regard to all these affections the term preventable, except by measures of exclusion and isolation, is applicable only in the indirect sense of the word. Preventive Medicine must be content to deal more with their effects than with their causes, That typhus is a common result of overcrowding seems sufficiently plain, though the rationale is unknown; with regard to typhoid, whose correlation to typhus is so close, there is evidence to show that it has been excited by preventable causes. But that both these scourges originate from complex causes at different times and in different places may be admitted. Not only do the exciting causes of one seem capable of exciting the other, but the contagion of typhus may cause typhoid and *vice versâ.* These are unfashionable doctrines, but I believe them to be true. The extent of their application is far greater than what appears at first sight, and as regards sanitary science, their importance is great, indeed.

I have shown that we know little of the actual cause or essence of specific disease. Still, measures to hinder the income of a contagious epidemic may be successful, and so be classed among those of direct Preventive Medicine. The efficacy of seclusion of families and communities during the prevalence of the plague has long been admitted in the towns of the Levant, where the established practice is for the Europeans to shut up their houses on the first appearance of the plague. So uniformly successful is this practice, that Dr. Russell asserts a case could hardly be specified in which a secluded family had been affected without the mischief being traced to some violation of the rule of confinement. In the severe epidemic of plague at Marseilles in the last century, the monks, who shut themselves up in their monasteries, escaped. So also Dr. Murtens preserved the Foundling Hospital at Moscow, which contained a thousand persons, so completely that not one died of the plague, though great numbers died daily in the city for some months.

It is plain that in Dublin, as in all maritime cities, measures should be taken to prevent the importation of epidemic disease, such as cholera, smallpox, yellow fever, and so on. In the epidemic of 1828 and 1830 many cases of yellow fever occurred in Dublin, and since then it has been directly imported from the West Indies into Sunderland. The difficulties of the question must be faced, and if a strict quarantine cannot be established between two countries so close as Great Britain and Ireland, and with

such a constant passenger traffic, let us do the next best thing. The efficacy of quarantine has been doubted, because contagious diseases have their latent period in the system. Disease may be actually working in a person coming from an infected district who may appear in good health and sicken after landing. That this is a difficulty is not to be denied, but it furnishes no argument against making the effort to prevent the spread of imported disease.

Let us put aside these cases of possible latent disease, and deal with those in which it is perfectly formed and unmistakable. Dr. Burke, in his paper read before the College of Physicians, animadverting on the public apathy shown as to the importation of smallpox, as contrasted with the feeling which existed respecting the importation of the cattle disease, says it affords another illustration of the principle that man loves gold more than life. It is plain that some preventive system should be resorted to where manifest disease has shown itself aboard ship. Were there no other reason for revision of the sanitary laws, the fact that such a system of prevention has never been brought to perfection in this country would be sufficient.

In the report of the Poor Law Commissioners for this year is given the correspondence with the authorities in Derry in reference to a case in point. A vessel was in harbour with actual smallpox on board, but the powers of the authorities seemed very imperfectly defined, or at least understood. The Poor Law Inspector and the Medical Officer proceeded on board to explain to the captain the arrangements made at the Union Fever Hospital for the reception of the men; but the captain declined their assistance, the officer of health of the city being in charge of the patients. He subsequently changed his mind, and applied to the coast-guard officer for permission to land the men in smallpox, but it then appeared that the ship had been placed in strict quarantine by the commander of the coast-guard, and the request was peremptorily refused. One patient died. The Commissioners endeavoured to find out by what authority the barque, curiously enough named the *Unanima*, had been put into quarantine, and were referred to the Admiralty instructions of the coast-guard, in which instructions it turned out that the officer of the coast-guard had no authority to prevent the landing of any person in smallpox. The Commissioners communicated with Government, suggesting that it was a case for a coroner's inquest, when it was decided that smallpox was not one of the diseases which rendered the ship liable to quarantine. The commander of the coast-guard was declared to have

acted under a misapprehension of his duty, the Admiralty regulations as to quarantine not applying to the disease in question, but to cholera. There is a letter from the Mayor of Derry, as to another case of smallpox on board ship, in which he complains that after the patient had been removed to hospital the master of the ship refused to permit the purification and disinfection of the ship. The magistrates and the corporation could not find that there was any authority to punish the master.

All this shows in what a state of confusion the question is. Here was an important town concerned as to the importation of a highly contagious disease, yet there was little unity of action between the various authorities; and, in the second case, the mayor, the corporation, and the magistrates of the city, are set at defiance by the captain of a coasting vessel.

The whole subject of quarantine and of the separation of the sick in communicable disease, relates to the great principle that sanitary legislation is to be mainly directed towards helping the community to do that which it cannot otherwise effect. Therefore, looking at its object, the public health, it should prevent any individual from interfering, though presumably for his advantage or profit, with the well-being or the health of his neighbours. As a nation, we are jealous of our personal freedom, but the good of the State requires that private interests must be secondary to the public weal.

I believe that in many cases the advance of knowledge will show that repressive laws for the good of the community will be found to harmonize with private interests. The pollution of rivers which carry away the refuse of manufactories, such as calico printing and paper works, exemplifies not alone the necessity of State control over the nuisance, but the advantage of repressive legislation to the manufacturer himself. Some short time since an influential deputation of calico printers waited on the Minister to show that great injury would be inflicted upon trade if his proposed measures in relation to the pollution of rivers were to become law. After stating their case the deputation, with the exception of one member, retired, who then said, "Though I felt compelled to come with this deputation I wish to say that you are to place no value on their representations. I have myself for some time done all that the proposed law requires. We save all the refuse, and return the water to the river in a state of greater purity than when it was first used. Our saving thereby amounts to thousands a year." In the alkali manufacture the pollution of the air by muriatic acid, and in the iron and other works by smoke, are analogous cases.

All that is wanting both for public health and the benefit of the manufacturer, is that the Government, being guided by scientific advice, the most eminent advice—as was had in these cases, should enact and firmly administer, laws for the advantage of the community. In the iron works alone, the waste of fuel has been in some cases calculated at eighty per cent., all of which goes to the deterioration of the public health. In speaking of contagion as connected with Preventive Medicine, the subject of disinfection, which will be fully dealt with by Dr. MacDonnell, must be noticed. If it be asked how far chemical, &c., agents destroy or modify the contagious principle, the answer with reference to sanitation is unsatisfactory and uncertain. Dr. Cameron has ably shown that the employment of these measures as they are commonly used is not to be trusted. He shows that chemical agents will destroy the life of the infusoria, but to produce this effect they must be used in a far more concentrated form than that too often employed by sanitarians. If contagion depends on germs these may be held to be imbued with that latent, as distinguished from the manifest, life of which Carus speaks—the one lasting for an indefinite time, while the other, once commenced, has its appointed development and termination. This is seen in seeds, in animal ova, and roots. "Thus," says Dr. Graves, "the curious fact has been observed of a bulbous root taken from the hand of an Egyptian mummy having germinated when placed in the soil. How happened it that this bulb remained for several thousand years in contact with the fingers of death, without its own vital principle being either extinguished or called into active operation? What power at once preserved that principle and held it in abeyance? And yet so it was. And age after age passed away without summoning into action that wondrous spell which could thus convert this long-enduring tenant of the tomb into the lily of the field, the Scriptural emblem of beauty, and the honoured type of the glories of vegetable life, beside the purity and brightness of whose hues even the raiment of Solomon appeared dull and faded."

Till the germ theory of contagion is established, till we know more of germ life, and of what preserves, what destroys it, and what replaces the latent by the manifest life, I believe that we must mainly trust for disinfection to cleanliness in the *widest* acceptation of the word.

But I must bring to a conclusion this imperfect sketch of a great subject. Those gentlemen with whom I have the honour to be associated will speak with authority on many questions, a few of which only I have been able to indicate;

for example, the exciting causes, if not the origin, of epidemic disease; the liability to disease, the laws of contagion, and disinfection; the relation of meteorology to the subject, sanitary engineering, and sanitary law.

The efforts of the Corporation of Dublin, especially in reference to the district drainage of the city, and to the splendid supply of pure water; the enlightened spirit in which they have met the Sanitary Association, the action of the heads of the University of Dublin as regards State medicine, the establishment of the Sanitary Association, and the union of the Royal Dublin Society with that body for the purpose of instructing the public mind as to Public Health, are all subjects for the earnest congratulation of every well-wisher of our country—of every one who is devoted to her real interests.

APPENDIX.

TABLE showing the *Births* and *Deaths* per 1,000 of the population living, in Edinburgh, Glasgow, London, and Dublin, in the eight years 1865–72 inclusive, with the number of persons to an acre in 1868 and 1872.

Years.	Edinburgh.		Glasgow.		London.		Dublin.	
	Births.	Deaths.	Births.	Deaths.	Births.	Deaths.	Births.	Deaths.
1865,	36	28	42	33	35	24	28	26
1866,	36	27	42	30	35	26	28	29
1867,	36	27	42	28	36	23	26	27
1868,	38	27	42	31	37	24	28	25
1869,	38	30	40	34	35	25	26	24
1870,	38	26	41	30	35	24	27	25
1871,	34	27	39	33	34	25	29	26
1872,	32	26	41	28	35	21	27	29
Mean of 8 years.	36·00	27·25	41·12	30·88	35·25	24·00	27·38	26·38
Years.	Persons to an Acre.		Persons to an Acre.		Persons to an Acre.		Persons to an Acre.	
1868,	40·0		88·9		40·1		32·8	
1872,	47·1		98·5		43·0		31·3	

Ratios of Deaths to Births.

	Per cent.
Edinburgh, . . .	75·7
Glasgow, . . .	75·1
London, . . .	68·1
Dublin, . . .	96·4

Ratios of Births to Deaths.

	Per cent.
Edinburgh, . .	132·1
Glasgow, . . .	133·2
London, . . .	146·9
Dublin, . . .	103·8

II.—*On the Discrimination of Good Water and Wholesome Food.* The substance of a Lecture by DR. J. EMERSON REYNOLDS, Professor of Analytical Chemistry, Royal Dublin Society.

INTRODUCTION.

The impurities often present in water used for drinking purposes, and the numerous adulterations to which articles of food and drink are liable, have frequently formed subjects for able and interesting discourses, in which not only has the nature of each impurity and adulterant been stated but the injury to the public health supposed to result from its ingestion has been placed in a particularly clear light. It is not now proposed to prove either that the practice of adulteration exists, since this is now unnecessary; or that impurities in water or in food can be connected with disease, because the general subject has been dwelt upon in the introductory discourse we have listened to with such pleasure and advantage, and will no doubt be dealt with in greater detail in the succeeding lectures of this course. We now seek only to convey such information as shall facilitate the distinction of pure from impure water, and of safe from unsafe food. For practical purposes it is only necessary for the consumer to be able to say whether or not his water or food supply can be regarded as wholesome. The *identification* of impurities and adulterants is the work of the chemist and microscopist; but it is often possible by very simple means and without the possession of any special skill to ascertain whether or not a particular article is fit for use in the animal economy. For this purpose it is often sufficient to ascertain whether the substance presents the characters which serve to distinguish it, and these characters can in most cases be easily recognised, though it is seldom possible to name the particular impurity or adulterant which may happen to be present without the possession of that "competent medical, chemical, and microscopical knowledge" required by the Adulteration Act. Information of the general kind referred to should be at the command of every medical man, and even of every head of a household; and our aim now is to bring together as much of this class of knowledge as happens to be available at present.

In carrying out the plan just mentioned it would obviously be inexpedient to do more than name the impurities and adulterants which have hitherto been detected in the several substances, and then to state, as briefly as possible, the distinguishing characters of each genuine article. This necessary course will be pursued in the following sections, in the first of which we shall deal with the water supply, and in the succeeding sections with the characters and impurities of the more important articles of food, excluding most of the so-called condimental foods on one hand and alcoholic liquids on the other.

POTABLE WATER.

Its impurities are mineral (lime and magnesia compounds, iron, sulphuretted hydrogen, &c.), and organic ("sewage contamination," including animal and vegetable nitrogenous matter, either capable of, or in process of decomposition, and the products of such change).

GOOD WATER should be free from colour, unpleasant odour and taste, and should quickly afford a good lather with a small proportion of soap. If half a pint of the water be placed in a perfectly clean, colourless, glass-stoppered bottle, a few grains of the best white lump sugar added, and the bottle freely exposed to the daylight in the window of a warm room, the liquid should not become turbid, even after exposure for a week or ten days. If the water becomes turbid, it is open to grave suspicion of sewage contamination; but if it remains clear, it is almost certainly safe.

We owe to Heisch this simple, valuable, but hitherto strangely neglected test. Frankland has shown that it is extremely delicate, and that the production of turbidity under the circumstances named is due to the minute quantity of phosphoric acid present in sewage.*

The Vartry water, *as delivered from the street mains* in Dublin at present, withstands this test perfectly; but it often becomes very impure when allowed to pass through ill-kept cisterns.

TEA.

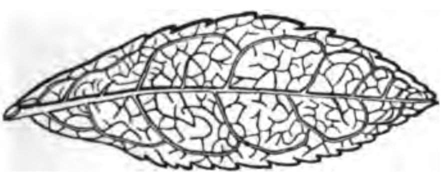
ADULTERATIONS.—There are two chief classes of teas—the green and black varieties. Under the first head are included the Hysons, Twankay, and Gunpowder; and under black

* The turbidity is caused by fungoid growths.

teas, Pekoe, Souchong, Congou, and Bohea. Both classes are subject to many serious adulterations at the hands of the exporters, and again on arrival in Europe. Mixtures of different kinds of tea are legitimately made in the course of trade for the purpose of suiting special tastes; but inferior varieties are often dishonestly mixed with the more costly kinds in order to increase profits. Leaving aside the consideration of "tea mixing," we find that green and black teas have often added the leaves of other plants. Those of the plum, sloe, ash, willow, poplar, hawthorn, beech, plane, orange, elm, horse-chestnut, elder, and oak, have been detected. These leaves are dried and prepared by roasting and "facing" so as to resemble genuine tea very closely. The product is sometimes called "Maloo mixture." Facing is used for the purpose of colouring the leaves and increasing weight. The bodies employed are China clay, gypsum, chalk, French chalk, black lead, Prussian blue, indigo, chromate of lead, carbonate and even arseniate of copper, Venetian red, and fine white sand. The powders are attached to the leaf-surface, by a convenient adhesive material.

Spent (exhausted) tea leaves are often dried, coloured with catechu and an iron salt, then faced, and the product mixed with good tea, "Maloo mixture," or Lie tea. The last named substance is made up of the tea and other leaves, sand, or plaster of Paris, bound together by starch or gum, in order to form granular particles which can be "faced," so as to resemble black or green gunpowder.

GENUINE TEA — When placed in a muslin bag and kneaded in warm water for a few minutes should not give up any powder quickly subsiding when the water is allowed to stand. The moist fragments of leaves when spread out should be compared with the very characteristic figure of the genuine leaf given below. The thick looped veins of the true tea-leaves are easily recognised.



COFFEE.

Adulterations.—Chicory, acorns, sawdust, roasted roots of various kinds, and grain, tan, croats, lentil seeds, baked livers, Venetian red, burnt sugar. Admixture with chicory is allowable if the compound be truly labelled.

Genuine Coffee—Should not cake when pinched between the fingers. If a little be thrown on cold water it floats, and very slightly tinges the water. Adulterated coffee sinks and rapidly colours the water brown.

COCOA.

Adulterations.—Chicory, cocoa husk, fats, starches, sugar, Venetian red, bole.

Genuine Cocoa.—Should not have a sweet taste, nor red colour. As much cocoa as can be piled up on a threepenny piece, when placed on a square of platinum foil, and strongly heated by a spirit lamp flame should burn almost completely away, leaving a very minute quantity of reddish coloured ash.* The same remarks apply to *chocolate.*

SUGAR.

Adulterations and Impurities.—Fine white loaf sugar is rarely adulterated, but coloured sugars sometimes contain chalk, sand, clay, starch, starch sugar, flour, dextrine, plaster of Paris. As impurities, fragments of cane, molasses, vegetable albumen, and sugar mites or *Acari.*

Good Sugar should be free from the least bitter taste, and ought to dissolve completely in water. Loaf sugar should give a perfectly clear and colourless solution; brown sugar, a clear but coloured liquid. If insects are present they float on the syrup, and appear as small specks, which can be easily removed for microscopic examination.

Bon-bons unless when mixed with harmless starch or injurious white or coloured mineral powders produce clear solutions when dissolved in water. If any insoluble residue is left the deposit should be allowed to settle, the liquid poured carefully off, and the powder collected, dried and heated on platinum foil. If white, and wholly combustible, it probably consists of starch. Chromate of lead (yellow), arseniate of copper (green), china clay and gypsum

* The microscope is alone able to detect mixtures of many organic bodies, as starches, fats, chicory, &c., in this and other cases. The simple tests given usually serve simply to exclude injurious substances.

(white), and most other injurious mineral pigments give insoluble and fixed powders. Sulphide of mercury or vermillion, though volatile when heated on platinum foil, is easily recognised by affording a heavy red powder on treatment of the sweets with water.

MILK.

ADULTERATIONS.—The chief is undoubtedly water; but skim-milk, annatto, brains, chalk, gum, tragacanth, and other gums; sugar, decoction of white carrots, starch, and turmeric, are stated to be used occasionally.

GOOD MILK should be free from acidity, and when allowed to stand in a vessel ought not to deposit solid matter. When placed in a tall graduated glass cylinder, it should throw up at least 10 per cent. of cream after standing for twelve hours. This is on the whole the least objectionable rough test that can be used.

BUTTER.

ADULTERATIONS.—Water, much salt, starch, flour, dripping, and lard.

GOOD BUTTER should not have a rancid smell. When a quantity is melted and poured into a small narrow phial, and the latter allowed to stand near to a good fire, the milky layer of water that falls to the bottom of the bottle should not form more than one-tenth of the total bulk of fluid. When the melted butter is poured off, the water should not strike a blue colour when shaken with a drop of tincture of iodine.

BREAD.

ADULTERANTS.—Water, rice, potato, and other starches, salt, alum, bone dust, clay, carbonate of magnesium, chalk, gypsum, and sulphate of copper; or impure from bad flour.

GOOD BREAD is sweet and agreeable to the taste. It does not present a mouldy appearance, and ought not to give a thick liquid when steeped in water. If bread becomes soft and sodden on standing it is probably adulterated with rice. When a piece containing much alum is dipped in a very weak solution of the colouring matter of logwood, the bread is quickly dyed of a purple tint.

Good bread ought not to contain more than 38 per cent. of water, and should burn to a very minute ash when heated on platinum foil.

FLOUR (WHEATEN).

ADULTERANTS AND IMPURITIES.—Rice, barley, dari, bean flour, "cones" flour, Indian corn, rye, potatoes, alum, gypsum, clay, ergot, darnel.

GOOD FLOUR should not be acid or musty, but ought to have a pleasant flavour. When a small quantity is burnt on platinum foil (see Cocoa) a scarcely perceptible residue of mineral matter should remain.

As flour containing ergot is poisonous, it is a matter of importance to be able to distinguish this dangerous product of disease in the wheat. We can accomplish this easily by shaking up the suspected flour with a mixture of one part of chloroform and six parts of strong spirit of wine. The ergot, if present in the flour, will float on the liquid and form a brown scum.

ARROWROOT (WEST INDIAN).

ADULTERANTS.—Potato starch, sago meal, rice, gypsum, china clay, chalk.

GENUINE MARANTA ARROWROOT is a dull white powder, which crackles strongly and in a peculiar manner when pressed between the fingers. When mixed with twice its weight of strong hydrochloric acid it yields an opaque jelly. Potato starch, under similar circumstances, affords a transparent jelly. When burnt on platinum foil arrowroot should leave a scarcely perceptible residue if unadulterated with mineral powders. A fragment of iodine placed on a warm plate near to the sample, colours M.A. chocolate brown, sago starch yellowish, wheaten starch violet, and potato starch a dull lilac colour.

MEAT.

BEEF—MUTTON.—Good meat should possess the following easily observed characters:—

1. It ought to be of a full, slightly brownish, red colour; neither of a pale pink tint on the one hand, nor of a deep purple hue on the other. If pink, disease is indicated; and if purple, the animal has probably not been slaughtered, but has died with the blood in it, or has suffered from acute fever.

2. It should have a marbled appearance, from the ramifications of little veins of fat among the muscles.

3. It should be firm, and elastic to the touch, and should scarcely moisten the fingers. Bad meat is usually wet, sod-

den, and flabby, with the fat looking like jelly or wet parchment.

4. It should have little or no odour, and not disagreeable; for diseased meat has a sickly, cadaverous smell. Any disagreeable odour is most easily detected when the meat is chopped up and drenched with warm water.

5. It should not shrink or waste much in cooking.

6. It should not become very soft and wet on standing for a day or so, but should, on the contrary, dry on the surface. (*Letheby.*)

PORK, if unsalted, should present the characters above stated; but the colour of the meat, if sound, is of very pale red tint. When infested by the dangerous parasite, *Trichina Spiralis*, the meat is usually of a dark colour. Unfortunately, the animal itself can scarcely be detected by the unaided eye; not so the *cysticerus*, or measle, whose little sac is often as large as a hempseed, and can be easily seen.

SAUSAGES are liable to partial decomposition, and then become poisonous, from whatever kind of meat they may have been prepared. Good sausage meat should be firm, not moist, gelatinous, and vesicular. It should be free from disagreeable smell and taste, and from acidity.

POULTRY.—It is unnecessary to say more under this head than to point out that this class of meat should fulfil the conditions 4, 5, and 6, given above.

FISH should only be used when fresh, and this condition can be easily ascertained. Fresh fish is free from offensive smell, and the flesh is not soft or gelatinous. It may be well to mention that fresh salmon or trout should not only have the well-known pink coloured flesh, but, when the finger is drawn quickly and firmly *across* the fish, the depression so caused ought to fill up quickly, and a corresponding elevation or ridge soon appear.

Sea fish is not tested in this way, but the rigidity of the fish is sufficient to indicate its fresh condition.

The bright red colour of fish gills is a sign of very little importance, as the gills are often artificially tinted.

ISINGLASS.

ADULTERANTS.—Though the best, or Russian isinglass, is an unimportant article of food, it may be well to mention that it is sometimes adulterated with gelatine and with inferior Brazilian isinglass.

GENUINE RUSSIAN ISINGLASS occurs in opaque white filaments, which do not become transparent when placed in

water, nor do they swell to a material extent. Gelatine, on the contrary, becomes transparent, and swells considerably. Russian isinglass affords a firm, translucent jelly; the Brazilian variety, for corresponding weights of material and water, does not afford nearly so firm a jelly, and it is much more milky.

VEGETABLES AND FRUIT.

Under this head it is only necessary to say that these articles of food should be invariably used in a fresh and ripe condition.

It is, however, often a matter of importance to be able to distinguish poisonous MUSHROOMS from those that are edible. It may be generally stated that mushrooms which have a disagreeable, styptic taste and a pungent smell should always be rejected. The edible mushroom used in this country has a white top and *pink* gills; as the fungus grows the gills change to a brownish or even nearly black colour. Mushrooms found in open pastures are almost always safe; those found near trees should be avoided.

PRESERVED FRUITS, &c., should not be eaten if mouldy or in a state of decomposition, as evidenced by effervescence or slight frothing, and an unusually acid taste. All preserves, if made in copper vessels, should be tested for copper by stirring a thick bright needle for some time through the preserve, mixed with a little warm water. If, after stirring and standing for an hour or so, the needle, on removal and rinsing with water, is free from any of the well-known reddish deposit of metallic copper, the preserve cannot contain any sensible quantity of the poisonous metal. The same test should always be applied to *Pickles.*

VINEGAR.

ADULTERANTS.—Sulphuric acid, and other mineral acids, water, "grains of paradise," chillies, corrosive sublimate (?). Arsenic and copper as accidental impurity.

UNADULTERATED VINEGAR is allowed by special enactment to contain one-thousandth of oil of vitriol. When paper moistened with vinegar containing this proportion of sulphuric acid is dried before the fire, no charring takes place until the paper is rather strongly heated, but if the proportion of acid is much greater blackening results before the paper seems quite dry. It must be remembered that this is but a very rough and indecisive test. When a piece of

clean and bright copper wire is immersed in vinegar, diluted with a little water, and heated nearly to boiling in a glass vessel, the copper quickly loses its colour and assumes a leaden hue if arsenic or mercury is present. Copper may be detected in a fresh sample, much diluted with water, by means of the steel needle, as described under *Preserved fruits*. Pungent substances, "grains of paradise," for example—may be detected by evaporating a quantity of the vinegar nearly to dryness in any convenient porcelain vessel. The residue should not have a fiery taste.

MUSTARD.

ADULTERANTS.—Ordinary "mustard" is rarely free from admixture with one or other of the varieties of flour, turmeric being added to improve the colour. The addition of flour in moderate proportion may be permitted on the score of convenience, but turmeric should not be added. For flour, china clay, plaster of Paris or chalk have been substituted, the colouring material being yellow ochre, or even the poisonous chromate of lead

MUSTARD should not become brown when moistened with a little "spirit of hartshorn," and when burnt on platinum foil, should leave but a small quantity of nearly white ash.

CAYENNE PEPPER.

ADULTERANTS.—Dense flours or starches, mustard, turmeric, ochre, vermillion (?), red lead.

CAYENNE when shaken with cold water, the mixture allowed to stand for a minute, and the liquid poured off should not leave any heavy red powder at the bottom of the vessel. It ought to leave but little ash when burnt on platinum foil.

CHEESE.

ADULTERANTS AND IMPURITIES.—Setting aside such colouring matters as annatto, saffron, &c., we find that the mineral pigments, Venetian red, (red lead ?), are used, and various flours or starches to increase weight.

CHEESE should not be eaten when in a mouldy condition, or when containing "jumpers." It ought not to become blue when touched with dilute tincture of iodine, and it should leave but little ash when burnt on platinum.

III.—*On Meteorology in its Bearing on Health and Disease.* A Lecture by J. W. Moore, M.D., Dubl., Diplomate in State Medicine, and Assistant Physician to the Fever Hospital, Cork-street, Dublin.

Part I.—*Modern Meteorology.*

Before I proceed to take up the subject of which it is my wish to speak more particularly to-day, it may be well to consider briefly what we mean by the term "Meteorology," in the modern acceptation of the word. And this I deem the more necessary, since many persons are inclined to deny altogether the existence of a weather-science; the triteness of the subject, viewed as a break-ice topic of every-day conversation, having—I suppose—tended to conceal from them the scientific aspect of the study of weather and climate.

Meteorology, in by-gone days, was limited in its application to appearances in the sky, whether atmospherical or astronomical in their character; and this was in strict accordance with the etymology of the word.* But there is no need to remind my audience that the meanings of words change in the lapse of years, and of such a change we have here an instance. The word is now used to denote a branch of natural philosophy which deals with weather and climate; its astronomical connexions are to a great degree severed, while many terrestrial phenomena are included within its vast domain, and are studied and explained under some of its many branches.

If we ask why it is that so important a subject has only of late attracted any general attention, or made any definite progress, the answer becomes easy when we call to mind the complexity of the phenomena with which it deals on the one hand, and the unique character of its relations to science and art on the other. The first point requires no comment. As regards the second, nearly all the sciences and many of the arts are pressed into the service of building a sure foundation for the science of meteorology. Thus mathematics, physics (of which it is itself a branch), chemistry, and biology, all lend their aid to this end, as do also the arts of telegraphy

* Τὰ μετέωρα = "Things in the air," "natural phenomena," "the heavenly bodies"—Cicero's "Supera atque coelestia."—(*Liddell and Scott.*)

and of photography. Until then all these had reached a certain degree of perfection, but little progress was to be anticipated for a science so dependent upon them.

Among meteorologists of old times, the names of Aristotle, Theophrastus, and Aratus, in Greece—of Lucretius, Virgil, Pliny, and Cicero, in Italy—stand prominently forth. But after these worthies had passed away, the sky again darkened for many centuries, until a fitful gleam of sunlight streamed in 200 years ago in the discovery of the barometer by Torricelli. Then came Fahrenheit, Reaumur, and Celsius, the fathers of thermometry; and about a century later, Dalton, Wells, and Daniell, whose names are inseparably bound up with hygrometry. One step further deserves notice:—the investigation of isothermal lines was commenced by Humboldt, and almost perfected by Dové; the latter of whom in his great work on the "Law of Storms," also drew attention to the theory of the winds, a subject which had attracted but little notice from the time when George Hadley, in 1735, published his treatise on the "Trade-Winds" in the *Philosophical Transactions* of the Royal Society.*

So far, the work had been done by individuals; but some twenty years ago, a completely novel epoch in the history of meteorology commenced in the founding of Meteorological Societies in America, and in several countries of Europe. The result was the collection of a vast amount of *trustworthy* material, which leading individual meteorologists such as Dové, in Germany; Buys Ballot, in Holland; Maury, in America; and Lloyd, in our own country, were not slow to utilize.

Hitherto very little was known as to the dependence of the direction and force of the wind on barometrical and thermometrical conditions, at least outside the tropics. But in 1854 a countryman of our own, Dr. Lloyd, the present esteemed and distinguished Provost of Trinity College, demonstrated the cyclonic character of most of the gales experienced in Ireland,† and so foreshadowed what is now universally known as *Buys Ballot's Law*—a law on which the whole of modern meteorology turns. As applicable to the Northern Hemisphere, it may be concisely stated as follows:—

"If at the same moment of time there be a difference between the barometrical readings at any two stations within a reasonable

* "On the Cause of the General Trade-Winds." By Geo. Hadley, esq., F.R.S., No. 437, p. 58.

† "Notes on the Meteorology of Ireland." *Royal Irish Academy Transactions*, vol. xxii., Science; 1854.

distance from each other, a wind will blow on that day in the neighbourhood of the line joining those stations, which will be inclined to that line at an angle of nearly 90°, and will have the station where the reading is lowest on its left-hand side."

In more homely language—"If on any day a person stands with his back to the wind, the reading of the barometer will be lower at all stations on his left-hand than it is where he is at the time."

Thus the *direction* of the wind is determined by differences in atmospherical pressure which are marked by differences in the height of the barometer. But further, the *force* of the wind also is chiefly regulated by the amount of those differences, or by what are called the "barometrical gradients." "The gradients adopted by the Meteorological Office, London, are expressed in hundredths of an inch of mercury per 50 géographical miles." *

In a paper on "Weather Telegraphy," by the present Director of the Meteorological Office, Mr. Scott, the following passage occurs:—

"The immediate result of the law is to show that whenever barometrical readings are lower over any area than over those adjacent to it, the air will sweep round that area as a centre, and the direction of its motion will be opposite to that of the hands of a watch. Conversely the air will sweep round an area of relatively high barometrical readings in the direction in which the hands of a watch move. The former of these motions is said to be *cyclonic*, the latter *anticyclonic*. These names are derived from the word 'cyclone,' the general name for hurricanes and typhoons, in all which storms the motion of the air takes place around an area of diminished barometrical pressure. . . . The actual movement of the air has no reference, either in direction or velocity, to the absolute readings of the barometer at the point where it is lowest, or to the distance of the particles of air which are in motion from that point, but is related almost entirely to the distribution of pressure in accordance with Buys Ballot's Law. The law gives the direction of motion, and its truth for these islands and the adjacent parts of the earth's surface is incontestable."

Having now shortly reviewed the history of meteorology from the earliest times to the present, I will give in as few words as possible an explanation of the climate of the British Isles (1) in summer, and (2) in winter.

We may lay down as aphorisms—

First. That hot air is lighter than cold air.

Secondly. That the rapidity with which the processes of

* "Barometer Manual," Board of Trade, 1871; page 21.

heating and cooling of air go on is in direct proportion to the amount of aqueous vapour contained in that air—dry air becoming heated or cooled more rapidly and more completely than moist air, other conditions being alike.

Thirdly. That, consequently, the air over large areas of land, being drier, becomes more rapidly heated in summer, and more rapidly cooled in winter, than air which is in contact with extensive water-surfaces; and,

Fourthly. That the radiation-heating power of dry land is greater than that of water, as also the radiation-cooling power of dry land is greater than that of water.

This group of facts is of paramount importance in climatology.

Now let us apply these facts. Over the centre of the great continent of Europe and Asia the air in summer will become much warmer than that over the Atlantic Ocean to the west, and over the Pacific Ocean to the east; the barometer will consequently fall over Russia, Siberia, and other inland countries, the isobars, or lines of equal barometrical pressure, curving round the point of lowest pressure, while it will remain tolerably high over the oceans I have mentioned. In accordance with Buys Ballot's Law a circulation of air will commence round the barometrical depression thus formed, a vast *cyclone* will become developed, the winds blowing against the hands of a watch, from S.W. in India and China (the S.W. monsoon), from S., S.E., and E. in Japan, and North-eastern Siberia, from N.E. and N. in North-western Siberia, from N.W. and W. over most of Southern Europe and South-western Asia.

In winter, on the contrary, the air over the central districts of Europe and Asia, rendered dry by the intense heat of summer, and its accompanying excess of evaporation, will become rapidly chilled to an extent of which we can form scarcely any idea, the air will be condensed, and the barometer will rise, while pressure will diminish over the Atlantic and Pacific Oceans, where the temperature is perhaps 60° or 80° higher. Thus, conditions, just the reverse of those observed in summer, will be established—an immense anticyclone will be formed, the winds circulating round and *out from* the centre of high pressure in a direction with the hands of a watch, blowing from N.W. and N. in Japan and China, from N.E. in India (the N.E. monsoon), from E. and S.E. in Russia and Southern Europe, from S.W. in the British Isles, and from W. in Northern Russia and Siberia.

I have said that we can form but little idea of the enor-

mous changes of temperature which take place in Central and Northern Asia between the seasons of summer and winter. But that these changes are sufficient to produce the great variation in barometrical pressure on which depends the varying wind-system of the continents of Europe and Asia in those seasons may be easily shown by a comparison of the range of temperature between July and January in an insular climate like our own, and at Yakutsk in Siberia, which is situated close to the centre of lowest and highest barometrical pressures in those months respectively. At Dublin the mean temperature of July is about 60° F., of January about 40° F.—a range of only 20°. The corresponding mean temperatures at Yakutsk are 74° F. and −40° F. respectively—a range of 114°. For weeks in summer the thermometer ranges between 80° and 90° at this place, while in winter it may descend 90° below the freezing point of water. Well does Humboldt observe:*—

"The inhabitants of the countries where such *continental climates* prevail seem doomed, like the unfortunates in Dante's 'Purgatory'—

'A soffrir tormenti caldi e geli.'"

Or, as Milton has so well expressed it—

"From beds of raging fire to starve in ice."

In the winter season the predominant winds over Scandinavia are south-easterly, but this apparent anomaly is in fact a beautiful fulfilment of the very laws it seems to contradict. I have said that in winter a barometrical depression exists over the North Atlantic Ocean. It is this which draws the wind from S.E. over Sweden and Norway, in strict agreement with Buys Ballot's law.

It will easily be seen how the summer continental depression influences the climate of the British Isles. Air is drawn from W. and N.W. over these countries, and as this air blows over the surface of a wide ocean, and from high latitudes, it is cool and moist. Do not these two words describe our summer? If all I have stated be true, these ocean winds will prevail chiefly on the W. and N.W. shores of Ireland and Scotland, which will thus have the rainiest and the coolest summer, while this season will be warmer and drier as we go eastward and southward, to the south-eastern counties of England. This is well illustrated in Mr.

* "Kosmos," vol. i., p. 352.

Buchan's Chart* of the Isothermals of the British Isles in July.

It is not necessary to consider at length the influence of the winter-system of barometrical pressure on our climate. During the earlier winter months a great stream of warm, very moist air, as a rule, flows north-eastward and northward over these islands round the Atlantic depression, the centre of which lies near Iceland. But this stream does not flow evenly. Along its eastern edge it is in continual conflict with the cold anticyclonic air, which is travelling westward from Russia and Siberia, and immense volumes of the latter are ever and anon rushing in to supply the place of those volumes of the warm air which, owing to their low density, have presumably risen from the earth's surface towards the higher strata of the atmosphere. This conflict between two such opposite currents of air causes our storms, and those violent and rapid alternations of temperature, which, as I hope to show you, are so prejudicial to health in the winter months.

The reason for the occurrence of these alternations of temperature will be explained when we remember that most of these gales, or *bourrasques* as they have been termed, are cyclonic in character, and that they generally cross the British Isles from S.W. to N.E., less frequently from W. to E., and still less frequently from N.W. to S.E. The southerly winds then which blow over the country in front of the centre of the storms are warm and moist, while the northerly winds, which prevail over those districts already reached and passed by the centre, are cold, and after a time dry. No better examples of this can be given than the remarkable gales of December 8th and 9th, 1872, and of February 2nd of this year. In front of the former temperature rose generally to about 50° over the south of Ireland, most part of England, and all of France; while it fell almost to the freezing point over those districts a few hours later when the centre had passed. The second gale I have referred to was accompanied by a range of 18° (Fahrenheit) over the whole of France.

The effect of the warm Atlantic air-current on the Isothermals of the British Isles is well represented in Mr. Buchan's Chart for January.*

Anticyclonic wind-systems sometimes prevail over western Europe, but much less frequently than cyclonic systems. They cause dry, often cold weather, and are much more persistent than cyclones.

* "The Temperature of the British Islands." By Alexander Buchan: *Journal of the Scottish Meteorological Society*, October, 1870.

This notice of modern meteorology would not be complete without some words on the telegraphic system of observation and storm-warnings. In a paper published a few months ago I wrote as follows :—*

"Dové's investigations on the 'Law of Storms,' followed by the enunciation by Professor Buys Ballot of his laws respecting cyclonic wind-systems, were supplemented in the year 1860 by the introduction of telegraphic meteorology, a step in advance, for which, as regards Great Britain, we are indebted to the late Admiral Fitzroy. Of late years this important branch of the science has been further developed and brought to a certain degree of perfection by the extension of the area of observation, and by the co-operation of public departments in most European countries with the Meteorological Office, London. To the agency of the last-named, which has been for some years connected with the Royal Society, and over which a countryman and fellow-citizen of our own, Mr. Robert Henry Scott, Fellow of the Royal Society, has ably presided in the capacity of Director since February 7th, 1867, we owe much of our present knowledge of the wind-systems of Western Europe. Telegrams are now sent daily to the office from three stations in Norway, one in Denmark, one in Germany, one in Holland, one in Belgium, nine in France, one in Spain, one in the Shetland Isles, one in the Hebrides, six in Scotland, five in Ireland, and sixteen (including Scilly) in England and Wales. These telegrams reach the office generally about 11 A.M. The observations are then reduced and discussed, and from them a daily weather report is drawn up, lithographed, and sent out early in the afternoon to many of the London papers. Daily weather charts are also published on the same sheet, and on them are drawn the isobars, or lines of equal barometrical pressure; the isotherms, or lines of equal temperature; curves illustrating the general direction of the wind; notes of the prevailing weather, rain, storm, &c., at 8 A.M., over most of Western Europe."

PART II.—*Influence of Meteorological Conditions on Health and Disease.*

Observations as to the influence of weather upon health are as old as meteorology itself—nay older, if we regard Aristotle as the founder of the science; for more than 400 years before the birth of Christ, Hippocrates of Cos, the "Father of Medicine," had penned his immortal "Aphorisms," and had written "Πέρι ἀέρων, ὑδάτων, τόπων" ("On Air, Water, and Places,") and "Πέρι διαιτῆς" ("On Regimen.") In these works we meet with passages as applicable to-day as they were twenty-two centuries ago. Let me quote but two or three of these:—

(*a*) "The changes of the seasons are a fertile source of maladies,

* *Irish Farmers' Gazette*, July 13th, 1872.

and in the seasons themselves great variations of cold and heat, and other things proportionally."

"(β) Some constitutions fare well or ill in summer, others in winter."

(γ) "Different diseases prevail at different seasons, or again subside."

Now mark the hurtful character of sudden changes of the weather :—

(δ) "In any season of the year, should heat prevail at one time, and cold at another of the same day, we may anticipate autumnal maladies."

Again, while writing on *Regimen*, he says :—

(ε) "These persons (of men) are more liable to sickliness in winter than in summer, and in spring than in autumn."*

There is reason to believe that the suggestions thrown out by the Greek physician were allowed to remain almost a dead letter. Certain it is that his doctrines as to the close relation of climatology to medicine became dimmed by the rust of time, and were neglected or forgotten. That in these countries but little attention was given to the subject is evident from the antiquity and popularity of the proverb—"A green Christmas makes a fat churchyard." Even Sydenham stated that a prevailing epidemic ceased on the approach of winter,† but on the whole his observations as to the dependence of disease on season are accurate and well worth perusal.

The first modern paper on the subject was a communication made to the Royal Society in 1797 by Dr. William Heberden, jun., F.R.S., on the "Influence of Cold on the Health of the Inhabitants of London.‡" The author shows that a difference of above twenty degrees between the mean temperature in London in January, 1795, and that in the same month of 1796 (the former being an excessively cold month, and the latter an equally mild one) caused the deaths in January, 1795, to exceed those in January, 1796, by 1,352.

* (α.) *Αἱ μεταβολαὶ τῶν ὡρέων μάλιστα τίκτουσι νοσήματα. καὶ ἐν τῇσιν ὥρῃσιν αἱ μεγάλαι μεταλλαγαὶ ἢ ψύχιος ἢ θαλψιος, καὶ τ' ἄλλα κατὰ λόγον οὕτως.*—"*Aphorisms*," sect. iii.

(β.) *Τῶν φύσιων, αἱ μὲν πρὸς θέρος. αἱ δὲ πρὸς χειματα, εὖ ἢ κακῶς πεφύκασι.*—*Ibid.*

(γ.) *Τῶν νόσων ἄλλαι πρὸς ἄλλας εὖ ἢ κακῶς πεφύκασι.*—*Ibid.*

(δ.) *Ἐν τῇσιν ὥρῃσιν, ὅταν τῆς αὐτῆς ἡμέρης, ὁτὲ μὲν θαλπὸς ὁτὲ δὲ ψῦχος γενηται, φθινοπωρινὰ τὰ νοσήματα προςδέχεσθαι χρή.*—*Ibid.*

(ε.) *Ταῦτα τὰ σώματα ἐν τῷ χειμῶνι, νοσερώτερα ἢ ἐν τῷ θέρει· καὶ ἐν τῷ ἦρι, ἢ ἐν τῷ φθινοπώρῳ.*—Πέρι Διαιτῆς, Book i.

† Swan's "Sydenham," 1769; p. 9.

‡ "Philosophical Transactions," Vol. lxxxvi., No. 11.

In my remarks on the present occasion I shall confine myself to the more immediate consideration of only two or three meteorological data in their influence on disease and death among the population of our own city. These data are *mean temperature, rainfall,* and *humidity*—the first the most important determining factor in the inquiry, as it is in truth the resultant of many others. My subject-matter I shall draw chiefly from the weekly, monthly, and annual returns of deaths in the Dublin registration district, published periodically, since the beginning of 1864, by the Registrar-General for Ireland, Mr. Donnelly, C.B. I purpose to deal with the subject under three headings:—

I. The influence of season on *Thoracic* and *Abdominal* affections respectively.

II. The influence of season on the progress of epidemics of recent years, namely, (1) *Cholera,* and (2) *Smallpox.*

III. The influence of season on four principal endemic and epidemic diseases, namely, (1) *Measles,* (2) *Whooping-cough,* (3) *Scarlatina,* and (4) *Fever.*

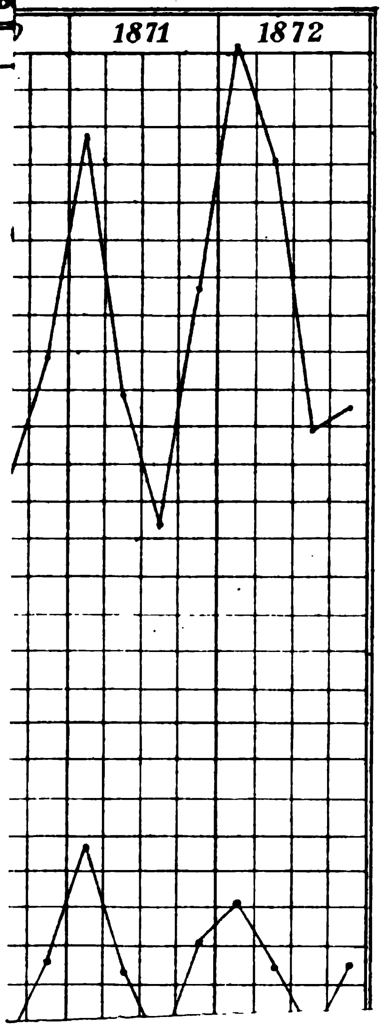
For the humidity-curves for the years 1864–68 inclusive, and for the rain-fall curve for 1864, I am indebted to the observations taken at the Ordnance Survey Office, Phœnix Park. For the remainder of these curves, and for that of the mean temperature throughout the whole period of nine years I am myself responsible.

It is to be regretted that statistics of sickliness apart from mortality are wanting in this country. How much a system of registration of disease is to be desired has been pointed out by Dr. Stokes in an admirable address delivered in this theatre a fortnight since. Already in the sister country local records of sickness have been compiled, and have been used in investigations similar to those whose results I now lay before you. I need instance only the "Weekly Tables of Disease" which are kept at Manchester, and the careful "Records of Sickness" kept in Islington—which last Dr. Ballard* has analyzed in the most perfect manner, so as to lay the foundation for the more accurate study of climatology in relation to health.

However, as such records have not been kept in Dublin, I must be content to deal with mortality alone, and while doing so I would crave your indulgence should I appear unnecessarily tedious or wearisome.

* Eleventh Report of the Medical Officer of the Privy Council, 1868. No. 3.

Compil turns of Deaths within the Municipal.
B oracic and Abdominal affections.



I. INFLUENCE of SEASON on (A.) THORACIC AFFECTIONS, and (B.) ABDOMINAL AFFECTIONS.

At the outset of our inquiry into the influence of meteorological conditions on the death-rate from thoracic and abdominal causes, we may lay down the two following propositions:—

(A.) *In* Summer *the tendency to sickness and death is chiefly connected with the digestive organs; diarrhœa and dysentery being the affections which are especially prevalent and fatal during this season. In* Winter *a similar tendency is noticeable in connexion with the organs of respiration; bronchitis, pneumonia, and pleuritis being the affections which are principally met with at this season.*

(B.) *In* Summer *a rise of mean temperature above the average increases the number of cases of, and the mortality from, abdominal affections. In* Winter *a fall of mean temperature below the average increases the sickness and mortality from thoracic affections.*

In proof of the truth of the first of these propositions in the case of Dublin, I would refer to Diagram I., in Section A of which curves are drawn, according to the same scale, of the deaths (α) from all causes, (β) from thoracic diseases, and (γ) from abdominal diseases, in Dublin during each quarter since the beginning of 1864. Regarding the first curve, that of the total deaths, its uniformly greater height in the *first* quarter of each year at once catches the attention. Again a depression occurs in the *third* quarter in eight of the nine years, the exception being 1868, a year of warmth and drought. We may take it then that the first quarter of the year is the most deadly, the third quarter the least so.

Turning to the second curve, that of deaths from thoracic affections, we find that its summits all occur in the first quarter, its depressions as invariably in the third quarter of the year. Another remarkable point deserves notice, namely, the pronounced influence of this curve in determining the contour of the curve of total mortality, especially in the winter months.

If we pass now to the third curve, that of the deaths from abdominal causes, the results are equally uniform. Thus its summits are reached (with one exception) in the third quarter, its depressions (without exception) in the second quarter of the year. The exceptional year was 1866, in the last quarter of which a fearful epidemic of cholera was accompanied by a considerable amount of diarrhœa.

So far then a dependence of the thoracic death-curve on season is observed—the season of low mean temperature, of a high per-centage of humidity (saturation being 100), and generally of an increased rainfall, coinciding with the summits of this curve. Similarly, the abdominal death-curve is influenced by a season of another type—a high mean temperature, a low per-centage of humidity, and, generally, a smaller rainfall, coinciding with the summits of this curve.

If the second proposition be true, the death-curves should be intensified by *extreme* mean temperatures—that of thoracic affections in winter, that of abdominal affections in summer.

Now if we look at the thoracic death-curve, we shall see that in the first quarters of 1865, 1867, and 1871, it was very acute indeed. In 1865 the mean temperature of the first quarter was 2·3° below the average (41·6°) temperature of that period during the nine years 1864–72; in 1867 it was 2·2° below the same, and in 1871 it was 1·1° above the same. It appears then that in the two former years a depression of 1° caused the death of about 100 persons from thoracic affections alone. The anomaly observed in 1871 is easily explained by a reference to the mean temperature curve. It will be seen that, although indeed the mean temperature of the first quarter of 1871 was about a degree over the average, yet that of six months ending March 31, 1871, was considerably below the average temperature of this long period. The accumulated effects of continued cold more than compensated for the comparatively mild temperature of January and February, 1871.

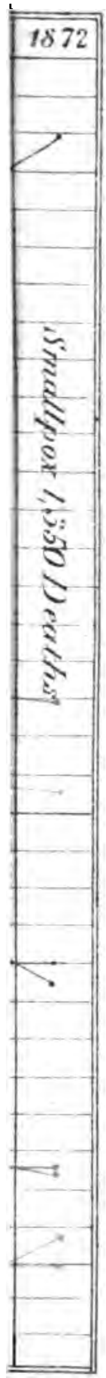
The lowest summits of the thoracic death-curve coincide with the mild winters of 1867–68, 1868–69, and 1871–72.

Apart from the cholera year 1866, the abdominal death-curve shows high summits in 1865, 1868, and 1870. The majority of my audience will not have forgotten the wondrous September of 1865, with its July temperature, and absolute drought; the burning suns of the summer of 1868; and the glorious weather of July, August, and September, 1870. The mean temperature of the third quarter of 1865 was 59·8°; of 1868, 59·3°; and of 1870, 59·2°, against an average temperature for the same period of 58·4°. In the summer of 1868, especially, the mortality from diarrhœa assumed alarming proportions, and in the Weekly Return of Births and Deaths in Dublin for August 22nd of that year, the Registrar-General writes:—

"The number of deaths from diarrhœa *registered* during the week amounted to 49, showing an increase of 23 on the number

Pl. II.

Dublin.



registered during the week preceding, and being 35 more than the average deaths from this disease in the corresponding week of the four previous years."

Providentially in the middle of August a copious fall of rain, amounting in one week to 303 tons of water on every acre took place, and within three weeks the plague was stayed!

I have given an example from the Registrar-General's Weekly Return of Births and Deaths of the effect of heat and drought in augmenting the mortality from diarrhœa. Let me quote from the same authority respecting the effects of the cold of January, 1867:—

"The deaths from bronchitis (*registered* during the fourth week) amounted to 80. The increased mortality from this disease is due to the extreme cold which prevailed; the mean temperature for the first three weeks of this year was 29·8°; during that period the thermometer fell to 2·8° on the 3rd instant, to 19·2° on the 12th, to 12·5° on the 16th; whereas during the corresponding three weeks of last year the mean temperature was 43°, and the deaths from bronchitis *registered* during the fourth week were only 31."

In the following week, that ending February 2nd, 1867, the deadly effect of this unusually cold wave was fully felt, no less than 119 deaths being referred to thoracic causes out of a total of 286 deaths registered.

The apparent anomaly of the high thoracic death-curve and of the comparatively mild mean temperature of the first quarter of 1871 has been alluded to and explained. That the explanation given is not unjustified by fact will, I think, be evident from a perusal of the returns of mortality in the weeks of January, 1871. A vigorous frost set in on December 21st, 1870, and from the 24th of the month until January 2nd, following, the ground was covered with snow. In the Registrar-General's return for January 7th, 1871, we read:—

"The very cold weather has increased the mortality from diseases of the respiratory organs. The average number of deaths from bronchitis in the corresponding week of the previous seven years was 29; during the past week 53 deaths from bronchitis, and 12 from pneumonia or inflammation of the lungs, were registered."

In Diagram II. I have given, as it were, a *résumé* of the yearly results, but a few words of explanation will be necessary. And in the first place, we must remember that the curve of total mortality is influenced by two factors especially—the presence of an epidemic, and the meteorological

conditions. To the first of these my friend, Dr. Grimshaw, will direct attention at an early opportunity, and I therefore purposely avoid dilating upon this subject at length, knowing well in how much worthier hands I leave it. Suffice it to say, that the abnormal curvé in 1866 was due to cholera, which caused 1,186 deaths, while the high curve of 1872 was due to smallpox, which proved fatal in 1,350 instances within that year.

But, apart from the effect on the general death-curves of these epidemics, the annual death-curve from thoracic affections appears to be anomalous in 1866, and in 1870, 1871, and 1872, as regards its relation to the mean temperature curve. "*Appears to be,*" but is nót. The low mean temperature of 1866 was due to no extreme winter-cold, but to a remarkably cool spring and summer—the mean temperatures of these seasons being 50·9° and 56·3°, against the average temperatures 52·5° and 58·4° respectively; 1870 was mild until the fourth quarter, which was much below the average as regards mean temperature (42·5° against 44·9°), but cold weather tells only after some continuance in early winter, and so we find the increased mortality thrown into the early months of 1871, which were in themselves mild.* As regards 1872, the high mean temperature of the first quarter (44·0°) is quite sufficient to account for the fact that the thoracic death-curve was comparatively low.

The annual death-curve from abdominal diseases presents an anomaly in 1866, 1867, and 1870. The epidemic constitution which accompanied the cholera of 1866 is more than sufficient to account for the comparatively high death-rate from diarrhœa in the two former years, while the hot and dry summer of 1870 more than counterbalanced the low mean temperature of the whole year in question, which was determined by a cold winter quarter and a very cold autumn.

I may be asked, "But is not cold weather 'bracing' and tonic' to the system?" Yes, it is so, doubtless, to the young and strong, to those in robust health and in the prime of life. These classes of the community are invigorated by the cold of winter, and may set the heat of summer at defiance. But far otherwise is it with "the *very*

* An illustration of this may be culled from Dr. Stark's report to the Registrar-General of Scotland for the year 1865 (Eleventh detailed Annual Report of the Registrar-General of Births, Deaths, and Marriages in Scotland, 1868, p. xlv.):—"The reason why March," writes Dr. Stark, "with its higher temperature, had nearly as many deaths as January, was chiefly owing to the fact that the prolongation of the cold weather, even though the cold did not increase in intensity, increased the number of deaths—those whose health was enfeebled by the first accession of cold not being able to withstand the effects of its continuance."

young, the *weakly*, and the *aged*."* Children under five years and the aged go down like grass before the scythe, when the keen frost-wind or the fiery heat of summer sweeps across the land.

The appended facts from the Irish Registrar-General's returns will prove this statement :—

"In 1867, 32·5 per cent. of all the deaths registered in Dublin were those of children under 5 years of age, and 19·5 per cent. were those of persons aged 60 and upwards.

"The corresponding per-centages for 1868 were 23·1 and 18·9, respectively. In the first quarter of 1867—so noted for its intense cold—the per-centages were: of those under 5, 24·9; of those over 60, 23·5. In the third quarter of 1868—the year of great heat—the numbers were: of children under 5, 41·5; of adults over 60, 16·9 per cent."

I will close this portion of my subject with the words of the Registrar-General of England :†—

"When the thermometer falls to the freezing point of water, the mortality is raised all over the country; and the population of London is excessively sensitive to cold; thus the corrected average deaths for the second week of January are 1,550, but the actual number of registered deaths this year (1864) was 2,427. The mean temperature of the preceding week, instead of 37·8°, had fallen to 26·7°; and the temperature of one chill night (Thursday, January 7th) had descended to 14·3°, or to 17·7° below the freezing point of Fahrenheit; and 877 lives were extinguished by 'the cold wave of the atmosphere.'"

TABLE I.—Showing the EFFECTS of COLD and HEAT on the MORTALITY in SCOTLAND during the Year 1868.

SEASON.	Average Mean Temperature of 10 years.	Mean Temperature, 1868.	Difference from Average Mean Temperature.	Death-rate pe cent.		Lives saved.	Lives lost.
				Average.	1868.		
	°	°	°				
First Quarter, .	37·9	40·6	+2·7	249	2·26	1,833	–
Second Quarter, .	49·7	51·0	+1·3	2·22	2·12	796	–
Third Quarter, .	55·3	57·4	+2·1	1·90	2·09	–	1,514
Fourth Quarter, .	41·9	41·5	–0·4	2·14	2·22	–	·673

* Registrar-General of England in the *Times* of Friday, May 7th, 1869.
† "Twenty-seventh Annual Report of Births, Deaths, and Marriages in England for 1864," p. xlvi.

II. INFLUENCE of SEASON on (A.) CHOLERA and (B.) SMALLPOX.

A. In an admirable report by Professor F. C. Faye, of Christiania,* we read as follows:—

"Most epidemics of cholera, especially those of extreme violence, have occurred in summer and autumn, so that in large towns, where the observations are less influenced by circumscribed local conditions, a direct relation has been established between the rise of the epidemic and that of the temperature. That warm air should be more favourable to an epidemic is explained by the fact that all exhalations, both from the ground itself, especially where it is swampy, and from all vegetable and animal organic matter scattered over its surface, are more rapidly developed; and as water also acts as a solvent on these materials, the further influence of moisture is easily understood. It has been matter for surprise that an incessant rain has a more healthy influence, although during it the moisture on and near the surface of the ground is very considerable; but as to this, it has been rightly observed that the exhalations from a purer water cannot be supposed to be particularly hurtful, and that therefore the quantity of water which turns swamps into seas, and in other places washes away impurities, acts advantageously in proportion."

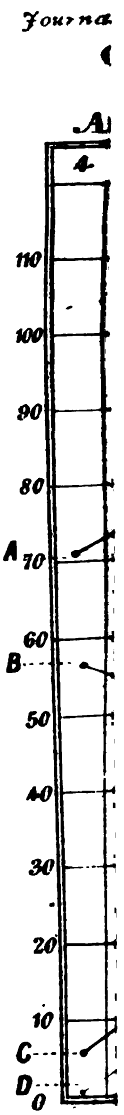
The author adds:—

"The months of August, September, and July, have on the whole been those of greatest mortality, and when the disease has commenced at rather an advanced period in the autumn, it has generally happened that the number of cases has been greater in the milder season than during a falling temperature."

These remarks of the Norwegian Professor are so true and so universally applicable that without further preface I would direct attention to Diagram III., in which I have drawn curves of the deaths from cholera in Dublin by weeks, and of the prominent meteorological conditions of the epidemic period in 1866. As this awful and mysterious disease is, unhappily, so rapidly fatal, we may safely compare the deaths in any week with the meteorological conditions of the week immediately preceding. I may state that on the whole, a comparatively low temperature prevailed throughout the epidemic period, and we may suppose that had this not been so, a far greater development of cholera might have occurred, terrible as the death-rate really was.

The first great mortality (41 deaths) was registered in the week ending September 1st, a week after the mean temperature had attained the height of 61°, and closely following

* "Om Cholera-Epidemien i Norge i Aaret 1853" ("On the Cholera-Epidemic in Norway in the year 1853").


Journa
A
4
110
100
90
80
A
70
60
B
50
40
30
20
10
C
D
0

on a fortnight of deficient rainfall. A gradual fall of temperature, a high humidity and a heavy rainfall then seemed to hold the epidemic in check. But the acme of mortality was reached in the middle of October, after a rise of 2° in mean temperature, and a very low rainfall. The increased mortality in the week ending October 13th is very remarkable when taken in connexion with the weather of the week before, which was continuously *calm, cloudy, foggy, damp, with a very high barometer, and a great deficiency of ozone* (the latter showing a mean value of only 10 per cent. at the Ordnance Survey Office, Phœnix Park).

The decrease in the mortality was consequent on a freshening and a change of wind from N.E. to S.W., a diminution of barometrical pressure, a moderate and continued rainfall, a rise in ozone to 70 per cent., and a gradually falling temperature. In the week ending December 1st we notice a final effort of the epidemic *after a week of low temperature.* But the influence of temperature seems, in this instance, to have been more than counterbalanced by deficient rainfall, a high barometer (pressure being a quarter of an inch higher than it had been for 3 or 4 weeks before), and the return of calm, damp weather, with a deficiency of ozone on three days. The coincidence of a high barometer with a great development of cholera has often been remarked, but striking exceptions are also on record. Keeping in view the fact that heavy rain and a strong breeze are most valuable detergents and disinfectants, I would suggest that the *calm weather* consequent on low barometrical gradients, so common in anticyclonic, or high-pressure systems, has more influence than the mere height of the barometer itself. In December the epidemic died out rapidly, and no death occurred later than the 29th of that month, on which day—it is most interesting to note—the intense frost of January, 1867, was ushered in by a fall of temperature amounting to 15° in a few hours.

That cholera tends to prevail in the warmer months of the year is sufficiently borne out by the history of the disease. In the accompanying Table are given the deaths from the disease by months in some of the great epidemics of late years, and the figures speak for themselves. In one case, that of Limerick, 1849, we meet with an early spring epidemic, and in January of the same year a large mortality from cholera occurred in England. But these exceptions only prove the rule. If from the totals we omit the Paris outburst of April, 1832, in which city the epidemic kindled into flame for the second time in July of that year, we have an increasing series of deaths from February to September, and a decreasing series from the last named month to December.

TABLE II.—Showing the DEATHS from CHOLERA, by MONTHS, in several EPIDEMICS, since 1832, in various CITIES and COUNTRIES of EUROPE.

MONTHS.	England, 1832.	England, 1849.	Paris, 1832.	Paris, 1849.	Dublin, 1849.	Limerick, 1849.	Dublin, 1866.
January, .	614	658	?	?	2	0	0
February, .	708	371	?	?	6	6	0
March, .	1,519	302	90	573	8	591	1
April, .	1,401	107	12,733	1,929	32	143	0
May, .	748	327	812	4,509	197	4	1
June, .	1,363	2,046	868	8,669	477	1	0
July, .	4,816	7,570	2,573	865	314	0	2
August, .	8,875	15,872	969	1,382	276	0	74
September,	5,479	20,379	357	1,142	298	1	270
October, .	4,080	4,654	62	115	49	0	508
November,	802	844	?	?	5	0	273
December,	140	163	?	?	0	0	66

MONTHS.	Sweden, 1834.	Sweden, 1850.	Sweden, 1866.	Christiania, 1833.	Christiania, 1850.	Christiania, 1853.	Christiania, 1866.	TOTALS.
January, .	?	?	0	0	0	0	0	1,274
February, .	?	?	0	0	0	0	0	1,091
March, .	?	?	0	0	0	0	0	3,084
April, .	?	?	0	0	0	0	0	16,345
May, .	?	?	0	0	0	0	0	6,358
June, .	?	?	4	0	0	0	0	13,628
July, .	30	0	483	0	0	6	0	16,659
August, .	5,904	209	943	0	0	164	8	34,676
September,	6,124	213	1,209	0	0	1,356	20	36,868
October, .	490	880	508	262	50	60	0	11,718
November,	58	342	30	538	37	11	0	2,940
December,	31	87	1	17	0	0	0	505

"Real epidemics of cholera," writes Professor Faye,* "in the more rigorous season of winter have very seldom occurred, while sporadic cases have very frequently shown themselves even in winter. At Breslau a winter epidemic prevailed in 1848–49, continuing from October till March with the same fatality as had characterized summer epidemics at the same place; and at Petersburg, as in several of the districts of Russia, cholera has prevailed in winter, although to a far less degree than in summer—so that the Russian physicians have often declared that the disease is prevalent in the winter quarter. At Bergen in Norway the epidemic of 1848–49 was also a winter epidemic. It is therefore not altogether without reason that cholera has been stated to observe no season, but if we take into consideration both the relative infrequency of its appearance in winter, and its impaired virulence under intense degrees of cold, this assertion as to the compatibility of the disease with a winter temperature experiences a very important limitation. Perhaps the explanation of the matter is not

* Loc. cit.

very remote. At Bergen, for example, the winter is often rainy and the air in proportion mild, so that the freezing of the earth's surface to any depth does not occur; and the winter of 1848–49 was really of this kind. It is well known also that cholera at Petersburg in winter time is almost exclusively confined to the unhealthy houses situated on the low and swampy banks of the Neva, belonging to an indigent labouring population; and indeed it is not strange that low-lying and overcrowded cellars, beneath which the soil has scarcely stiffened, with a favourable and confined oven-temperature, should foster the contagion, and occasion a constant though tardy propagation of the disease. Whether conditions of this kind held at Breslau I am unable to say, but in any case it is certain that violent epidemics during severe winter-frost very rarely, if indeed ever, occur."

Professor Faye goes on to say that, while the epidemic (of 1853) was at its worst at Christiania, the atmosphere was steadily warm and the air in addition clear and very still. This continued for about three weeks, during which the daily numbers of cases, which were then at the highest, scarcely varied. At this point of time—the middle of September—the air was set in motion by a strong and stormy north-west wind, and, remarkably enough, the number of cases fell *next day* to about one-half. Similarly, at Bergen, during the epidemic of 1848–49, a strong and cold north-easterly gale, supervening on a lengthened period of milder temperature, caused a considerable fall in the number of cholera cases.

B. In discussing the influence of season upon the progress of the recent epidemic of *small-pox*, we cannot, as with cholera, compare the meteorological conditions of the week before with the death-rate of any week. Small-pox has a definite period of incubation during which the disease lies dormant in the system, and it seldom kills before some days have elapsed from the earliest development of the symptoms. Making additional allowance for a few days delay in registration, I purpose to compare the deaths in a given week with the weather of three weeks before, and in doing this I am only following the precedent of all writers on the subject.

Small-pox is essentially a disease of winter and spring. In an accompanying Table I have entered the results of an analysis of most carefully compiled returns as to the prevalence of small-pox in Sweden during the eight years 1862–69 inclusive. The returns are extracted from exhaustive annual reports by Dr. Wistrand as to the morbility of Sweden, and are the direct fruit of an admirable system

of disease-registration which has been in operation for many years in Sweden, and also in the other Scandinavian countries. From these statistics it appears that the greatest prevalence of small-pox is observed in May, the cases in that month being 13·7 per cent. of the total cases occurring in the year; while the least prevalence is observed in September, when only 3·9 per cent. of all the cases in the year occur. From November the monthly number of cases is high, but from May a rapid decline in the prevalence of the disease takes place.

TABLE III.—Showing the prevalence of SMALL-POX in SWEDEN by MONTHS in the years 1862–69 inclusive.

YEAR.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	TOTAL.
1862,.	28	55	43	40	56	53	66	67	46	42	25	52	573
1863,.	35	60	64	56	99	124	152	91	54	85	122	108	1,050
1864,.	163	148	157	222	267	314	187	130	160	168	244	317	2,477
1865,.	323	417	504	662	806	662	441	219	187	248	399	422	5,290
1866,.	647	484	498	636	619	530	315	184	89	101	254	159	4,516
1867,.	260	289	396	468	551	427	401	321	227	281	321	456	4,398
1868,.	595	544	619	813	770	567	471	228	211	186	378	608	5,985
1869,.	635	464	649	855	1,005	678	609	309	199	141	252	277	6,073
Totals	2,686	2,461	2,930	3,752	4,173	3,355	2,642	1,549	1,173	1,252	1,990	2,399	30,362

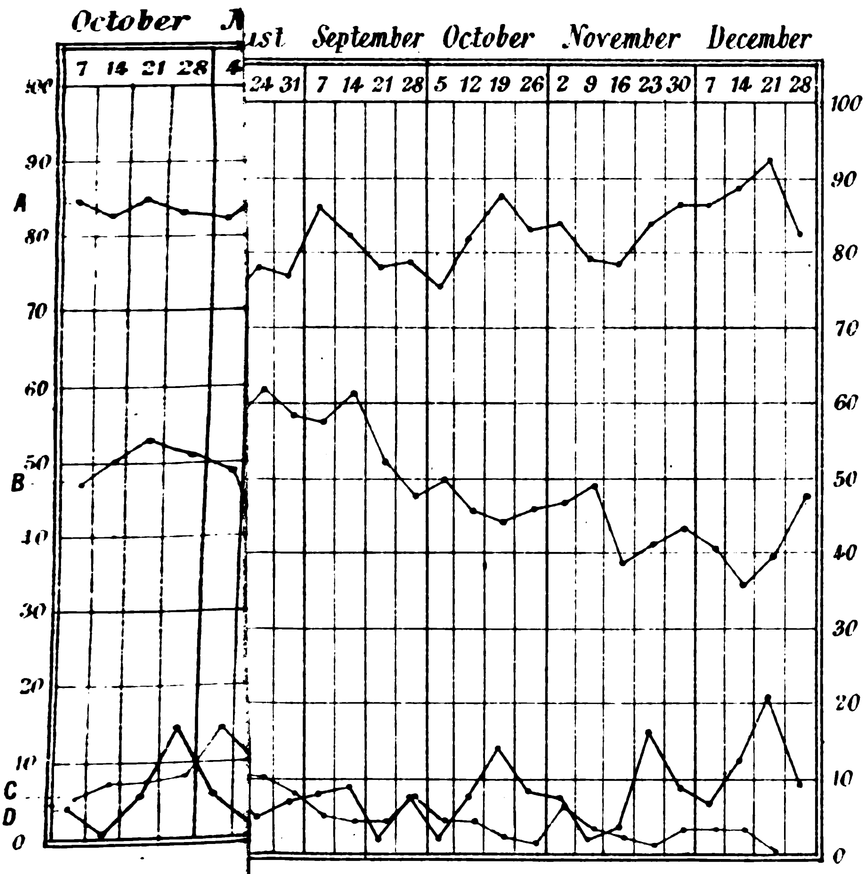
When due allowance has been made for difference of climate, these results agree very closely with the observations which have been recorded in this country on the relation of small-pox to season. A writer in the *Medical Times and Gazette* (March 11th, 1871) observes :—

"There is some reason for believing that the variations of the epidemic (of small-pox) from week to week are influenced to a certain extent by atmospheric conditions and more especially by variation in temperature."

He then quotes a series of remarkable coincidences between the fluctuations of mean temperature and those of the small-pox mortality in London during the winter of 1870–71. In the number of the same journal for May 13th, 1871, we read :—

"The epidemic has now lasted a good six months. It may be regarded as assuming a distinctly epidemic form in November, shortly after the mean temperature of the air had fallen decidedly below 50°. In the progress of the seasons we have now arrived at a time when this mean temperature is again reached. The mean temperature of the last three weeks, as recorded at Greenwich, has been 50°, 50·7°, and 49·7°. It is customary about the second week in May for some check in the consecutive weekly rises of temperature to take place, but after this in the ordinary or average

Gi chief Meteorological Curves for the same period.



mallpox.

imals of an Inch. (10 = 1 inch, 20 = 2 inches)

progress of events the steady rise towards the summer temperature may be expected to set in, and with it there is at least a hope that the epidemic will begin to fade."

A week later, the same writer, presumably, says:—

"The sudden fall of deaths in London from small-pox which occurred last week, namely, from 288 to 232, occurring about three weeks after the mean temperature of 50° was reached, appears to be confirmatory of the favourable hopes we expressed last week, that the epidemic had, for this season, arrived at its climax."

And so it had, for although the decline was occasionally interrupted, the virulence of the epidemic was broken in May, in accurate fulfilment of the anticipations which had been grounded on a consideration of the influence of temperature on its progress.

In Diagram IV. I have projected curves of the weekly deaths from small-pox during the recent epidemic in Dublin, and of the coincident meteorological conditions. It is much to be regretted that delays in registration have at times seriously marred the contour of the death-curve, which, I may mention, commences in the week ending October 7th, 1871, when an uninterrupted weekly mortality from small-pox began, and concludes in the week ending December 28th, 1872, when the first break occurred in the weekly death-return of the disease. Comparing the curves we find that a rise of mean temperature to 53° in the third week of October is followed by a decline in the mortality about three weeks latter. After the mean temperature had again fallen below 50°, the death-curve shows a tendency to rise, and a great development of the disease begins at the end of December, the mean temperature of the week ending the 9th of that month having fallen below 35°. The peak observable in the second week of January includes 36 deaths, which had only then been registered, although they had occurred in the South Dublin Union Workhouse since December 17th. Towards the end of February, a slight decrease in the deaths appears to be connected with the mild temperature of that month.

The peaks and depressions which follow are largely accounted for by irregular registration, but the greatest severity of the epidemic was experienced in the first half of April, a short time after a period of cold which was very intense for the time of year, snow and hail having fallen in large quantities (with keen north-easterly winds) on every day from the 21st to the 27th of March. The mean temperature of

this period was scarcely 37°, or nearly 8° below the average. The number of deaths now began to decline, the mean temperature in two weeks (April 13th and May 4th) rising above 50°. The depression in the death-curve in the week ending June 1st, and the great rise in the following week depend on irregular registration. With the rise of mean temperature to between 55° and 60° in the middle of June, the weekly number of deaths falls permanently below thirty early in July.

It is interesting to note that abundant rainfalls seemed to be followed by remissions in the severity of the epidemic. A reference to the Diagram will show this very clearly; and the converse also, for the acme of the epidemic closely followed a period of comparatively dry weather and lower humidity.

But in connexion with the late epidemic, as regards Dublin, one of the most remarkable evidences of the dependence of the disease on climatic influences is found in the fact that in March, 1871, a well-marked tendency to an epidemic was noticeable. Local outbreaks of the disease took place in various parts of our city, and fatal cases occurred at Cork-street Fever Hospital. By the increasing temperature, however, the disease appeared to be held in check, notwithstanding the importation from England of many cases, until with the advancing autumn it blazed into an epidemic.

III. Influence of Season on (A.) Measles, (B.) Whooping-cough, (C.) Scarlatina, and (D.) Fever.

I now pass to the third and last division of my subject, the influence of season upon our four principal endemic and epidemic diseases—endemic, alas! for their home is ever in the midst of us, and the graphic term "Fever-nest" is a significant and no less truthful recognition of the mournful fact. As briefly as possible I shall pass the four diseases in review in the following order:—(1) *measles*, (2) *whooping-cough*, (3) *scarlatina*, and (4) *fever*.

A. Following the death-curve from *measles* which I have projected in Diagram V., we notice (1) the periodical epidemic character assumed every second year or so by the disease, and (2) the remarkable tendency to prevail in the second and third quarters of the year which is shown by it. At present we have to do only with this last peculiarity. In epidemic years, on three occasions, the greatest mortality fell in the third quarter, and on one in the second quarter.

The non-epidemic years display an opposite tendency, the acme falling in the *first* quarter on four occasions. But in three of these instances, this acme was really only the dying-out of an epidemic (1866, 1868, and 1870). Practically then we may disregard these years, and we may look upon measles as essentially a disease of the spring and summer quarters.

Seeking for further light, I was led to analyse the weekly returns of deaths from measles during the 9 years, 1864–72 inclusive, in Dublin. As a result of the investigation I found that on an average the highest mortality fell in the twenty-eighth week of the year, and was 4·2 deaths—that from this period the average weekly number of deaths declined with slight oscillations to 0·6 in the fifty-first week, remaining very low until the twelfth week, when it again permanently reached two. Now the average mean temperature of the twenty-fifth week of the year for the 9 years under consideration was 58·6°. We may, therefore, conclude that a temperature higher than this is not favourable to the spread of an epidemic of measles. Similarly, the average mean temperature of the ninth week was 43·1°, while that of the forty-eighth week was 42·1°. As a low mortality from measles followed close upon the latter temperature, and lasted until the former temperature was reached in the early spring, the inference to be drawn is that a temperature below 42° is as unfavourable to the spread of the disease as a temperature above 59°. These results are in strict accordance with those arrived at by Dr. Ballard,* who says that the only condition concerned in the arrest of the spread of measles in summer is the rise of the temperature of the air above a mean of 60°, while towards winter a fall below 42° also distinctly tends to check the disease.

Proceeding from these results we see that the cold spring and summer of 1867 were especially favourable to the spread of the epidemic of that year, and that while, on the whole, the summers of *all* the epidemic years were comparatively cool, those of three non-epidemic years were hot and dry (1864, 1868, and 1870).

B. The consideration of *whooping-cough* need not delay us long. As was to be anticipated from the frequency of chest complications attending it, the disease invariably prevails most in winter, the greatest mortality generally falling in the first quarter of the year. Three epidemics of

* Eleventh Report of the Medical Officer of the Privy Council, 1868. No. 3, pp. 54–62.

whooping-cough occurred within the nine years 1864–72, and all of these reached their acme in January and February. It is curious to observe that the epidemics occurred in comparatively mild seasons, namely, those of 1866, 1868, and 1871. The epidemic of 1866 also was slow in dying out, as if the cold of the second quarter of that year had kept up the mortality. It would seem, indeed, that intense cold tended to check the disease, while moderate cold favoured its prevalence. And this view is borne out by an analysis of the weekly death-rate. The average weekly deaths numbered 5·9 in the second week—allowing then three weeks for (1) the period of incubation, (2) the length of the illness, and (3) the delay in registration, we find the average mean temperature of the fifty-first week in the nine years to have been 42°—a temperature which very remarkably corresponds with that of the three epidemic quarters 42·2°, and which is at least 3° above the average mean temperature of the coldest week in the year.

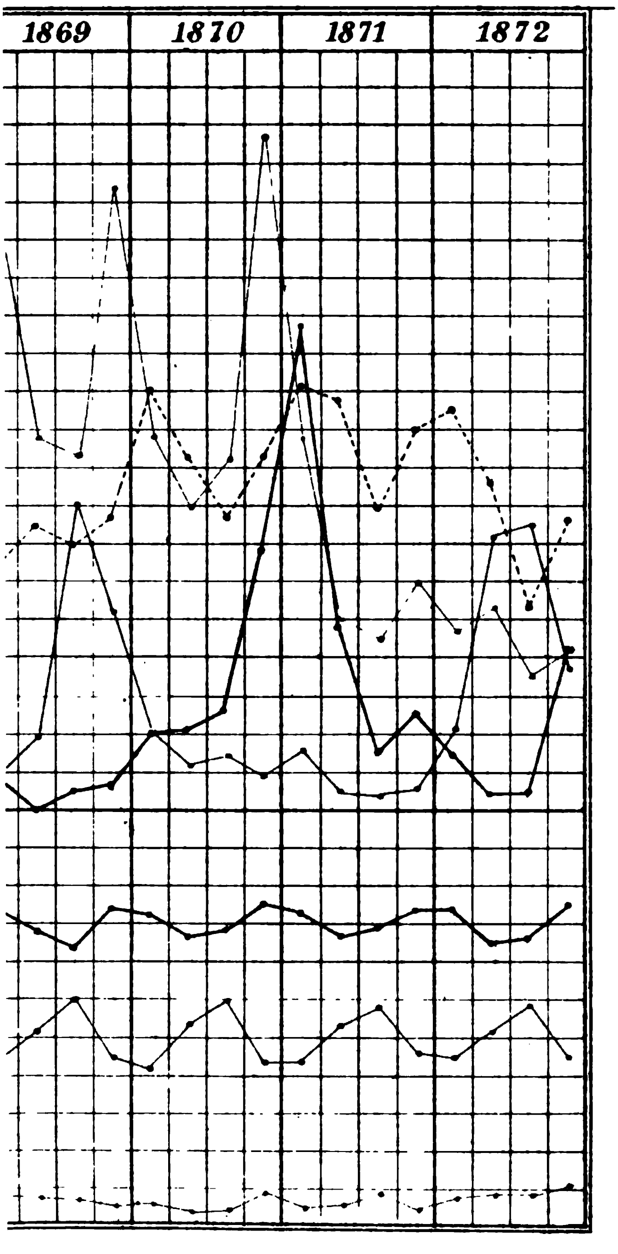
The lowest death-rate from whooping cough is met with in the twenty-eighth and twenty-ninth weeks, or about the middle and end of July, and accordingly, by a reference to Diagram V., we find the mortality to be, as a rule, lowest in the third quarter. The average mean temperature of the twenty-fifth week in the nine years was 58·6°, that of the twenty-fourth week having been 56·8°.

A rise then above this last temperature seems to favour the spread of the disease, although from Dr. Ballard's observations we learn that extremely high temperatures are inimical to the epidemic character of whooping-cough.

Besides the pronounced minimum of mortality from whooping-cough which I have described, another minimum falls in the twenty-first week, after which a recrudescence of the disease is observed for some weeks. With this temporary rise a low humidity, and a temperature of about 50° seem to be associated. Dr. Ballard especially mentions this June development of the disease as being most marked in Islington, and the Report of the Scottish Registrar-General for 1868 contains the following passages from the pen of Dr. Stark:—

"The first advent of really warm weather, during the past year, greatly increased the deaths from measles and whooping-cough; but the continuance of the warm weather rapidly diminished the mortality." "When the cold easterly winds began to blow in March, the deaths from whooping-cough in the eight towns, which numbered 87 during February, increased in March to 155, but under the influence of the spring weather fell to 145 during April, and to 131 deaths during May. During the high temperature of

·m the Quarterly Returns of Deaths within the Municipal Curves from four principal Endemic and Epidemic Diseases.



June, however, the deaths from whooping-cough rose to 165, the highest they had been during any month of the year; but instead of increasing during the much warmer months of July and August they rapidly fell, numbering 135 deaths in July, 121 in August, and 92 in September—the lowest number of deaths from whooping-cough during any month of the year."

C.—"*Scarlatina*," observes the Registrar-General of England,* "discovers a uniform well-marked tendency to increase in the last six months, and attain its maximum in the December quarter, the earlier half of the following year witnessing a decrease." He illustrates this remark by a table, which is appended, showing the deaths in London from Scarlatina by quarters during four years.

TABLE IV.—DEATHS in LONDON from SCARLATINA.

YEARS.	March Quarter.	June Quarter.	September Quarter.	December Quarter.	TOTAL.
1861, . . .	420	326	467	1,145	2,358
1862, . . .	774	677	841	1,165	3,457
1863, . . .	880	1,055	1,519	1,621	5,075
1864, . . .	749	593	805	1,095	3,242
1865, . . .	566	–	–	–	–

From Dr. Wistrand's Reports on the Morbility in Sweden, I have compiled a table, which shows that scarlatina is as a rule most prevalent throughout that country in November, and least so in August, results which agree tolerably closely with observations in England, except as regards the September quarter.

TABLE V.—Showing the prevalence of SCARLATINA in SWEDEN by MONTHS in the years 1862–69 inclusive.

YEARS.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	TOTAL.
1862, .	371	246	194	177	88	93	99	157	134	95	108	116	1,878
1863, .	163	195	200	187	89	112	141	248	203	303	356	269	2,411
1864, .	303	369	307	312	203	247	192	220	217	202	376	563	3,511
1865, .	467	456	505	562	609	657	568	487	629	1,220	1,214	1,089	8,413
1866, .	1,122	930	763	802	948	818	781	706	659	863	970	962	10,324
1867, .	759	493	550	555	431	374	260	222	209	281	318	283	4,735
1868, .	273	215	232	255	218	205	263	188	260	386	564	644	3,704
1869, .	741	590	551	551	738	726	688	644	819	982	840	740	8,610
Totals	4,199	3,494	3,303	3,351	3,324	3,232	2,992	2,867	3,180	4,332	4,741	4,616	43,586

If we study the scarlatina death-curve in Diagram V., we shall be struck (1) by the remarkable epidemic period of 1867–70, and (2) by the great tendency displayed by the

* Twenty-eighth Annual Report of Births, Deaths, and Marriages, p. 38.

disease to prevail in the fourth quarter of the year. Even in non-epidemic years this tendency is generally noticed.

From an analysis of the weekly death-rate from scarlatina in Dublin during nine years, I have found that the disease was on the average most fatal in the forty-sixth week (8·2 deaths), and least fatal in the twenty-fourth week (1·9 deaths). The average mean temperature of the forty-third week was 47·9°, that of the twenty-first week was 52·1°. It would seem then that scarlatina shows a tendency to increase when the mean temperature rises much above 50°, while a fall of mean temperature below this point in autumn checks the further rise of the mortality.

Dr. Ballard draws inferences which confirm my results. He says:* —

"1. *That a mean atmospheric temperature of about* 60°, *or between* 56° *and* 60°, *is that most favourable to the outbreak of scarlatina.* 2. That for its free development it is necessary that the humidity of the atmosphere shall not much exceed 86, or be much less than 74. 3. That a higher temperature than 60° does not appear to be in itself unfavourable to the spread of scarlatina. 4. *That a fall of mean temperature below* 53° *tends to arrest an epidemic of the disease.*"

The remark made by this author as to the influence of humidity may explain the great dip in the mortality during the hot but *dry* summer of 1868.

But if a fall of temperature below 53° tends to arrest the disease, why is it that the mortality undoubtedly *continues high* during the colder winter months? In Dublin it continues *very high* until the ninth week, and *high* until the nineteenth week. Here we are brought for the first time face to face with one of the most important factors in all sanitary problems, namely, overcrowding—or to give it a Greek dress—"ochlesis." We all know that scarlatina is not only one of the most contagious diseases in existence, but also that the *materies morbi* (whatever it may be), appears to be very easily diffused and remains in an active state for a lengthened period. Hence the difficulty of disinfecting the bed-chambers of scarlatina patients.

In these facts is contained the solution of our problem. As winter approaches, the instinct is to diminish the sources of ventilation, but among our poorer fellow citizens, badly clothed, and with inadequate supplies of fuel, unrestrained freedom is given to this instinct, but with most deplorable consequences. Every chink and crevice through which the outer air might gain access to the overcrowded tenements is

* Loc. cit., p. 65.

eagerly sought out and effectually closed. And it is under these circumstances that scarlatina, favoured by the high and unwholesome temperature of the rooms, runs like wildfire among many families in the poorer parts of the city. But the mischief does not end here, for the contagious powers of the disease are called into full play, and so the richer and more affluent quarters of the city suffer in their turn from this dire pestilence.

We must not forget also that in winter the throat complications of scarlatina are likely to be more severe and more fatal than in summer and autumn.

D. *Fever* may well be described as both an epidemic and an endemic disease. In 1865 and 1866 it prevailed as an epidemic; it is however never absent from our city, and so its title to be considered an endemic disease also is established. Following the fever death-curve in Diagram V. we notice the remarkable tendency to prevail in the first quarter discovered by the disease. To this rule there are but two exceptions, one in 1864, the other in 1869. With regard to the former year, the increase in the second quarter may fairly be set down to (1) improved registration and (2) a commencing epidemic tendency. With regard to the latter year, we may remember the open mild character of the weather in the first two months, and the cold spring which followed. In fact, fever appears to depend especially on the weather. But in our consideration of fever it would be most desirable to isolate two forms of the disease—typhus and typhoid, or enteric, fever. With the former I have grouped the so-called simple continued fever, for I believe it to be more closely allied to typhus than to typhoid, and we must also remember that cases of simple fever are sometimes cases merely of typhus without any eruption—non-maculated typhus as it is termed.

Unfortunately, prior to the year 1869 no distinction between these two forms of fever was made in the Registrar-General's returns, but I have analysed the returns for the past four years in which such a distinction was made, and the results may be looked upon as at all events approximate to the truth.

In the first place, during the nine years, fever in general proved most fatal in the third and fourth weeks of the year (with 10·1 and 9·7 deaths on the average respectively), and least fatal in the 28th and 29th weeks (with 4·4 and 4·3 deaths on the average respectively), that is, the disease was most severe about the period of greatest cold, and least so early in July.

In Table VI., in which the year has been divided into thirteen periods of four weeks each, corresponding results are brought out.

TABLE VI.—Showing the MEAN NUMBER of DEATHS from FEVER, and the MEAN TEMPERATURE, in 13 periods of 4 weeks, during the years 1869–72.

No. of Period.	Mean Number of Deaths from Fever.	Mean Number of Deaths from Typhus.	Mean Number of Deaths from Typhoid.	Mean Temperature.	Per cent. of Typhus.	Per cent. of Typhoid.	Mean Fever Deaths, 1864–72.
				°			
I., .	34·4	19·2	15·2	40·5	55·8	44·2	34·4
II., .	28·0	16·4	11·6	43·9	58·6	41·4	32·8
III., .	27·6	16·4	11·2	43·6	59·4	40·6	30·7
IV., .	27·5	17·0	10·5	47·0	61·8	38·2	27·9
V., .	32·5	17·5	15·0	49·4	53·8	46·2	31·6
VI., .	26·3	15·3	11·0	54·3	58·2	41·8	29·8
VII., .	22·3	11·5	10·8	59·3	51·5	48·5	20·9
VIII., .	20·5	12·5	8·0	61·0	61·0	39·0	20·7
IX., .	21·7	11·0	10·7	58·2	50·7	49·3	21·4
X., .	21·0	12·5	8·5	53·9	60·0	40·0	21·6
XI., .	27·5	14·2	13·3	48·1	51·6	48·4	25·7
XII., .	30·5	17·3	13·2	42·0	56·7	43·3	31·5
XIII., .	23·9	11·2	12·7	39·8	46·8	53·2	28·1
Average, .	26·4	14·8	11·7	49·3	55·8	44·2	27·5

With respect to this and the following table it is necessary to explain that the fall in death-rate noticed in the thirteenth period, or last four weeks of the year, is apparently due to delay in registration at Christmas time.

TABLE VII.—Showing the MEAN NUMBER of DEATHS in DUBLIN from (1) MEASLES, (2) WHOOPING-COUGH, (3) SCARLATINA, and (4) FEVER; and the MEAN TEMPERATURE, in 13 periods of 4 weeks, during the years 1864–72.

No. of Period.	Mean Deaths from Measles.	Mean Deaths from Whooping-Cough.	Mean Deaths from Scarlatina.	Mean Deaths from Fever.	Mean Temperature.
					°
I., . .	4·3	17·5	22·3	34·4	39·1
II., . .	5·1	15·4	21·4	32·8	41·7
III., . .	6·8	11·0	16·0	30·7	41·4
IV., . .	12·1	10·4	16·4	27·9	46·9
V., . .	11·0	8·3	14·5	31·6	50·8
VI., . .	12·5	7·0	12·5	29·8	54·9
VII., . .	14·4	5·4	11·1	20·9	59·5
VIII., . .	12·1	4·4	13·5	20·7	60·0
IX., . .	9·7	7·8	13·7	21·4	58·6
X., . .	8·7	6·7	18·5	21·6	54·2
XI., . .	9·7	8·2	26·7	25·7	48·7
XII., . .	5·0	11·4	26·4	31·5	43·5
XIII., . .	4·2	11·9	22·8	28·1	43·4
Average, . .	8·9	9·6	18·1	27·5	49·4

In Table VII. I have grouped the mean number of deaths from fever, as well as those of the other endemic diseases I have been considering, into thirteen periods of four weeks each. From this table it will be seen that fever becomes very fatal in autumn when the mean temperature falls below 54°, the mortality continues to rise with the falling temperature until January and February are past. Early in March the mortality declines, but rises again at the beginning of May, coincidently, it would seem, with a *lower humidity*. The decline is then very rapid, and the minimum is reached in the seventh and eighth periods, that is in July, and the first half of August. It is worthy of note that the sudden fall in the number of deaths in the seventh period follows the rise of mean temperature above 54° at an interval of some three or four weeks. Temperatures higher than 54° would, therefore, seem to have a controlling influence on the prevalence of fever, while temperatures below 54° seem to favour its development.

Table VI. shows the apparent influence of season on the two forms of fever—typhus and typhoid. The death-rate from typhus reaches a minimum in the ninth period, while the minimal death-rate from typhoid has already occurred in the eighth period, this form of fever exhibiting—as the summer rolls by—a decided tendency to increase at an earlier period than typhus. In this same table the calculated per-centages of the two forms are also entered, and a striking increase in the per-centage amount of typhoid is noticed towards the close of the year. The highest per-centages of typhus are met with, on the contrary, in the seasons of winter, spring and early summer.

The reason for all this is not far to seek. Typhus is often intimately related to overcrowding, and bronchial or thoracic affections are amongst its most frequent complications. Hence we should expect to meet with it especially in the colder seasons. Typhoid fever, on the other hand, is connected with a specific contamination of air or water by sewage matter, and its secondary phenomena are developed generally in connexion with the digestive system. Hence, a great prevalence of this form of the disease was to be looked for in the warmer seasons, and more particularly at a time when the first autumn rains had washed into drinking wells and other sources of water supply the decomposing matters which had been innocuous so long as the skies were clear and the sun still high in the heavens. But this perhaps is only theoretical, and on the domain of theory I may not trench.

For this inadequate and imperfect sketch of a great subject I ask your indulgence. Within the restricted limits of a lecture, it would be impossible to do full justice to the theme on which I have addressed you; indeed each separate topic would claim a special lecture for itself. If, however, some interest has been excited in a novel and all-important inquiry my efforts will not have been made in vain. And yet, all that we have considered to-day forms but one chapter in the study of the relations between meteorology and health. The influence of light on health, first shadowed forth by our great countryman, Dr. Graves,* has been ably handled by Dr. Forbes Winslow.† In the essay on "The Influence of Light," by Dr. Graves, we meet with this touching and eloquent passage:—

"I need not observe that the flowers and leaves of all plants court the light; indeed this tendency is manifested sometimes in a very curious manner. This is exemplified in the various flowers which adorn the dark and comfortless abodes of the tradesmen in the Liberties of Dublin. These poor creatures (for however poor the being is, or however confined by the nature of his employment, he never forgets the green freshness and living loveliness of nature) delight in flowers and birds, and in their windows will frequently be seen a geranium, almost as sickly as its owner, turning its lank and stunted leaves with unvarying constancy towards the light."

„Die Pflanze selbst kehrt freudig sich zum Lichte."

SCHILLER—"*William Tell.*"

Among other cognate inquiries I would particularize only the works of Dr. Angus Smith on "Air and Rain," of Dr. Cornelius Fox on "Ozone and Antozone," and of Professor Buhl, of Munich, on the "Relation between Typhoid Fever and the Height of the Underground or Subsoil Water."

When, indeed, we reflect on the vast extent of the subject of Meteorology and Health, we are ready to exclaim with the great Physician of Antiquity—

"Life is short, and Art long; Occasion fleeting;
Experiment dangerous, and Judgment difficult." ‡

But in conclusion, one word as to the practical bearing of our investigations. It would seem that some of the diseases we have been considering tend to prevail in the warm seasons of the year, others in the cooler seasons. There is, further, only too good reason for believing that the mortality of many diseases included even in the former

* "Studies in Physiology and Medicine," p. 26.

† "Light: its Influence on Health." 1872.

‡ "'Ο βίος βράχυς, ἡ δὲ τέχνη μακρή· ὁ δὲ καιρὸς, ὀξύς· ἡ δὲ πεῖρα, σφαλερή· ἡ δὲ κρίσις χαλεπή."—HIPPOCRATES—"*Aphorisms.*"

class is increased by overcrowding and its attendant evils in winter, while the influence for evil of this flagrant breach of sanitary law on winter maladies is almost beyond belief. Overcrowding, alas! is but another name for poverty. And poverty means—want of fuel, deficient food, deficient clothing. What an argument have we here for the promoters of coal funds, soup kitchens, and clothing clubs? If it be true that cold gives rise to bronchitis, inflammation of the lungs, pleurisy, and a host of other "ills that human flesh is heir to," is it not incumbent upon us, sanitary reformers, and pioneers of *Preventive* Medicine, to obviate so far as lies in our power the evil effects of cold? In the case of scarlatina, again, and other infectious diseases, let refuges be provided to which we may remove from the sick-room the still healthy members of a family stricken by the disease. As regards the maladies of summer, too, we may do much. The providing of wholesome food, the interdicting of unripe fruit and putrid vegetables, the free use of suitable disinfectants in sewers and latrines, and above all, a pure water supply, such as we already possess, will have the happiest results.

But of all the diseases, typhus fever is, perhaps, the most preventable, depending as it does so largely on overcrowding and bad ventilation. How are we to deal with it from a preventive point of view? Let us hear the Registrar-General of England* on this point—

"Fire is a necessity of life in this climate, and a warm hearth mitigates the severity of winter. Fire is as much required by the poor as by the rich, and a tax on coals like a tax on salt presses with undue severity on people of small means."

And so it is. Our poorer fellow-citizens have to do battle with snow and ice, hail and tempest. Their weapons of defence in this otherwise unequal warfare must be raiment, food, and warmth. Lo! there on the journey of life lies the wounded, the helpless wayfarer, cold, and naked, and hungry—be you the good Samaritans.

* Twenty-seventh Annual Report, for 1864.

IV.—*On the Geographical Distribution of Disease.* The Substance of a Lecture by James Little, M.D., Professor of the Practice of Medicine in the Royal College of Surgeons.

In dealing with the subject of the Geographical Distribution of Disease it is desirable to keep in view the two great classes of disease. In the admirable lectures of Dr. Stokes and Dr. Moore you have already heard a good deal about one of these classes, namely, *Zymotic* Diseases. The derivation of this term almost suffices to explain the sense in which we apply it. It comes from a Greek word which signifies "leaven," and under the term are grouped a number of diseases in which the disease-process is supposed to bear an analogy to that which is set a-going when leaven is added to dough. One of the most prominent members of the zymotic group is small-pox. When a certain quantity of the *contagium* of small-pox is introduced into the system nothing is observed for some time, but after the lapse of a certain number of days, varying from nine to twelve, according to the mode in which the poison is introduced into the system, changes begin in the individual—he becomes ill, various symptoms are developed, and there is a multiplication of the poison in his body. One of the essential characters of these zymotic diseases is that the poisons which produce them are all received from *without*—the individual gets the poison from some source external to his body.

The other class of disease is the *Diathetic.* This term is derived from a Greek word which signifies "disposition." There exists in the bodies of some people a disposition or predisposition to a certain disease, or more correctly to a certain kind of vital action which results in disease, and an essential feature of this class is that the cause of the disease is generated *within* the system of the sufferer, and is not received from without, as is the case in diseases of the zymotic class. Gout and scrofula are examples of diathetic diseases. Men do not exhibit the phenomena of gout or scrofula because

some poison has gained access to their bodies from without, but because there is something wrong in the chemico-vital changes going on in their own bodies, because in them there is a disposition or predisposition to form an unhealthy kind of blood and tissue. Diathesis is sometimes hereditary and sometimes acquired, but whether hereditary or acquired it may be intensified or lessened by the habits of the individual and the circumstances in which he is placed.

Some diseases belonging to both these groups prevail in every part of the world, or nearly in every part of the world, but the majority are confined to certain areas.

I. Some are confined to a very limited area, beyond which they are never, or very seldom found; for instance, along a certain part of the coast of Hindostan and the opposite coast of Ceylon, between 15° and 20° north latitude, and extending not more than sixty miles inland, there prevails a constitutional disease known as Beriberi. In persons affected by it the blood becomes watery, and ultimately dropsy occurs; it prevails principally in gaols and overcrowded barracks. In this district many conditions unfavourable to health exist; we do not know the precise ones which determine the occurrence of Beriberi, but we do know that by attention to ventilation, the use of pure water, the avoidance of damp and cold, and the administration of small quantities of iron, persons living within the affected area may be protected from the malady.

II. Other diseases, again, though usually confined to a limited area, extend beyond it under exceptional meteorological conditions. For instance, in the equatorial region of America, extending from 48° north latitude to 35° south latitude, Yellow Fever prevails. In some part of this region it is always present, but it requires a temperature of 72° Fahr. for its propagation, and hence, although there is constant communication between the countries in which the disease prevails and England, and ships have several times arrived in British ports with the disease, it has never spread in these islands; it has spread, however, when introduced into ports in southern Europe, where the temperature and other circumstances were favourable to the reproduction and diffusion of the poison on which it depends.

III. In Cholera, again, we have an instance of a disease which has for some time prevailed in nearly every part of the world, and under very varied climatic conditions, but which nevertheless has a limited area of *persistent existence* from which its epidemic journeys commence, and where, after it has died out in other lands, it continues to prevail.

IV. In Influenza we have an example of a disease which has no persistent area, but which, arising sometimes in one part of the world and sometimes in another, spreads thence with great rapidity.

V. Finally we have diseases such as Goitre and Leprosy, which are met with in nearly every country in the Old and New World, but only in limited districts of these countries, where certain unhealthy influences generate and perpetuate them. Goitre is found in India, in the New World, in parts of England, and in Switzerland, but always where the water used for drinking contains lime in considerable quantity. Leprosy is a terrible disease, which once existed here. It prevailed in various parts of Great Britain and Ireland, and up to the end of the last century in the Shetland Islands; at present it prevails in India, in North America, in Equatorial Africa, and elsewhere, but whether in the warm or cold regions, in the Old World or the New, it always presents the same characteristics. It is an hereditary constitutional disease, prevailing among people who are badly fed, and live in filth and misery.

If, setting aside the two last classes, we proceed to inquire into the circumstances which cause the limitation of certain diseases to certain areas, we will find that temperature is the most powerful—so powerful is it found to be that some years ago Mr. Keith Johnston, the eminent geographer, constructed a map in which he divided the world into three great disease realms, according to isothermal lines; that is, according to lines passing through places of mean annual temperature. If we look at Mr. Johnston's map we will find that the isothermal lines do not run parallel with the equator; nearness or distance from the equator is indeed the circumstance which has most effect in determining the temperature, but other circumstances often interfere to disturb the influence of this condition, and hence the lines of mean annual temperature at some points approach and at some recede from the equator.

The TORRID Disease Realm has its centre at the equator, where the annual mean temperature is 82° Fahr., and extends north and south to the isothermal line of 77° Fahr.; in it therefore we find the Southern States of North America, Mexico, and the northern part of South America, the great region of Central Africa, Arabia, India, and China. This realm includes the most unhealthy portions of our globe. Most of its diseases are of the zymotic class, and in their symptoms resemble the affections which prevail among ourselves during the heat of summer and autumn. Over the

entire of this disease-realm intermittent fevers prevail. In the portion of it which lies in the New World yellow fever is the most wide-spread and fatal malady, while in that which lies in the Old World cholera is the most important.

Intermittent and remittent fevers are also frequently spoken of as malarious fevers, because they are supposed to depend on an emanation from the soil, to which the term malaria has been applied. The fevers which prevail in this country are called *continued* fevers, because in them from the commencement of the illness until its termination there is persistent fever, that is, persistent elevation of the temperature of the body above the limits of health; in intermittent fevers, on the contrary, after the patient has suffered for some hours, the fever subsides and does not return until the following day or until the second day. Some intermittent fevers are comparatively mild while some are rapidly fatal, but whether the fever has been a mild or a severe one the person who has suffered from it—instead of being protected from a second attack, as is the case after recovery from our continued fevers—has a permanent impression made on his constitution, so that for years after he now and then shows symptoms of the febrile paroxysm. Though it is within the tropics that these fevers are most prevalent, they are seen in a severe form in Southern Europe, and in a less severe form in Britain, and wherever they prevail a certain condition of soil exists, namely, an alluvial soil, which, never thoroughly dry and never completely flooded, is daily exposed to a hot sun; heavy rains on the one hand and long continued drought on the other prevent the development of malaria, and it is most intense during the autumn when the damp ground is covered by decaying vegetable matter. In the deltas of great rivers, where an immense body of water finds its way to the ocean through innumerable small streams, as is the case with the Ganges and the Nile, malaria is intense; it also prevails where extensive systems of irrigation are carried out, and where there are undrained swamps. Some of those who are now present have no doubt visited the beautiful Basilica of St. Paul, a few miles from Rome, and have heard how the monks who have charge of it are obliged each summer to leave it on account of the fatal fever which is generated in the undrained Campagna, yet this region was at one time quite healthy, when the aqueducts and watercourses, which are now in ruins, carried off the water and kept the soil dry.

I have already mentioned a few of the characteristics of yellow fever, the most conspicuous disease found in the

torrid realm in the New World, but as cholera, the prominent disease in the torrid realm in the Old World, possesses a far greater interest for us, I shall devote to it a little more attention.

Cholera,* as all here are aware, has from time to time prevailed over nearly all the world, but in most countries after raging for some time it dies out, and is no more heard of for years; but there is one part of the earth's surface where this is not the case. Somewhat similarly typhus fever has under certain conditions, which I am sure you will hear fully described by my friend Dr. Grimshaw, prevailed extensively in many parts of Great Britain and of the Continent, but in most of these situations it dies out as soon as the crowded camps or other aggregations of human beings among whom it has prevailed have been broken up, but in this country, and more especially perhaps in this city, typhus fever in isolated cases is constantly present, and under certain favouring circumstances becomes epidemic. Cholera has in Lower Bengal, and especially in the great towns of Dacca and Calcutta, a home; when its ravages have ceased elsewhere, it still prevails in this region, sometimes appearing in isolated cases, and sometimes putting on the character of an epidemic. Here it seems to find the conditions necessary for its permanent existence or constant reproduction, or perhaps I should rather say in Lower Bengal there are circumstances which prevent the disease dying out as it does elsewhere. In the great Delta of the Ganges we find everything which is necessary for the development of malaria in its greatest intensity, an alluvial plain so flat, that for 200 miles inland it barely rises above the sea level, exuberant vegetation, vast expanses of jungle, a great network of rivers and canals, and a tropical sun; in the habits of the people too we find everything favourable to the spread of an epidemic. "A bustee or native village," says Dr. Tonneore, "generally consists of a mass of huts, constructed without any plan or arrangement, without roads, without drains, ill-ventilated, and never cleaned. Most of the villages and towns are the abodes of misery, vice, and filth, and the nurseries of sickness and disease. In these bustees abound green and slimy stagnant ponds, full of putrid vegetable and animal matter in a state of decomposition, whose bubbling surfaces exhale, under a tropical sun, noxious gases, poisoning the atmo-

* The most complete account of cholera, and especially of the routes by which its epidemics have travelled, will be found in "A Treatise on Asiatic Cholera," by C. Macnamara, Surgeon to the Calcutta Ophthalmic Hospital. London: Churchill. From this work the accompanying Map is, with certain alterations, borrowed.

sphere, and spreading around disease and death. These ponds supply the natives with water for domestic purposes, and are also the receptacles for their filth. The arteries which feed these tanks are the drains that ramify over the village, and carry out the sewage of the huts into them. Their position is marked by a development of rank vegetation.

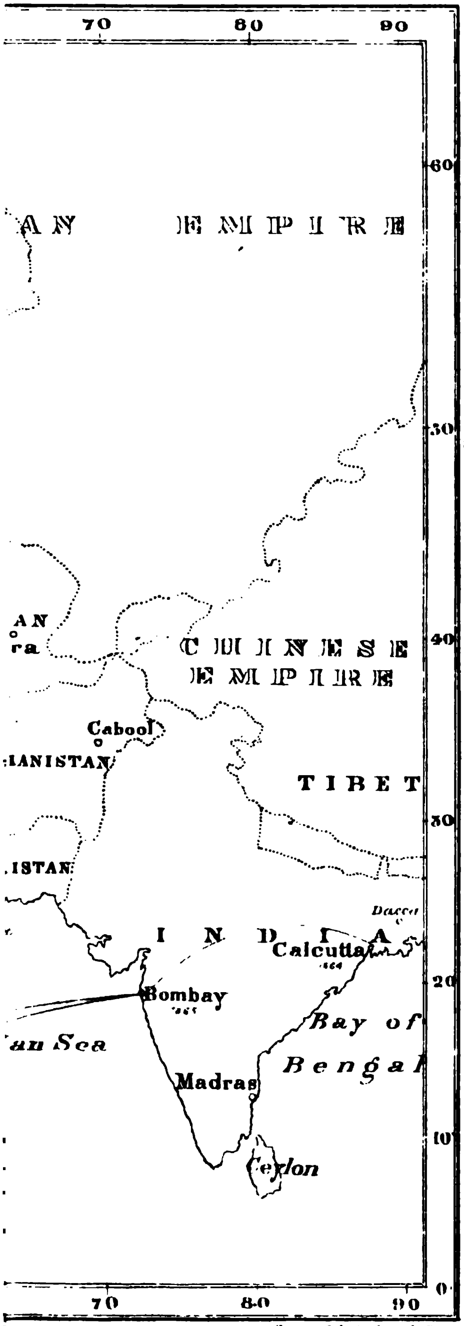
"The entrances to these bustees are many, but not easily discoverable, while the paths are so narrow and tortuous that it is difficult for a stranger to find his way through them. The huts are huddled together in masses, and pushed to the very edge of the ponds, their projecting eaves often meeting together, while the intervening spaces, impervious to the rays of the sun, are converted into necessaries, and used by both sexes in common. In these huts often live entire families, the members of a hut all occupying the single apartment of which it is not unfrequently composed, and in which they cook, eat, and sleep together, the wet and spongy floor, with a mat spread on it, serving as a bed for the whole.

"The distinction of caste extends to these bustees; but it assumes in these places a new form, by the fact that some portion of them, called parrahs, are inhabited by people of one occupation or trade, whose habits of living give a distinctive feature to each parrah, and modify its general appearance. Amongst the Hindoos the worst and filthiest bustees are those occupied by Gowallahs, Coloos, Chumars or Moochees. Amongst Mahomedans the worst and filthiest bustees are those occupied by Garrywans and Khollasees. In bustees occupied by Gowallahs, in addition to the usual filthy tank, the water of which is used by them to dilute the milk sold for public consumption, there are pools of liquid filth covering a large surface, the area of one of them I have ascertained by actual measurement to be over 150,000 square feet.

"None of these villages possesses a single road, or thoroughfare properly so called, through which a conservancy cart or even a wheelbarrow can pass in order to remove the filth. This filth is laid at the door of every hut, or thrown into a neighbouring cesspool. Not a single hut in the village is properly built. The dwellings are badly constructed, crowded together without regard to ventilation or the means of being kept clean. The principal defects are due not only to ignorance and utter disregard of all sanitary considerations by the ryots, but also to the apathy and negligence of the impropriators, who care very little about the welfare of their tenants provided that their rents are paid regularly."

This is a faithful and not overdrawn description of village life in Bengal, and it presents to us conditions eminently favourable to the prevalence of such a malady as cholera. Observation at home has shown that some diseases, markedly typhoid fever and cholera, are very frequently spread by the emanations from the sick finding their way into the drinking water, and thus gaining access to the bodies of the healthy. Now, the drains which Dr. Tonneore describes, though usually stagnant and invariably receptacles for the refuse of the huts between which they flow, during heavy rain are flushed, and discharge their contents into the neighbouring tanks from which the drinking water of the village is drawn. Need we be surprised then that in Lower Bengal cholera never dies out? and it is from Lower Bengal that it invariably sets out on its epidemic journeys. The routes it has followed on these journeys have been various, but the more closely we examine them the more convinced will we be of the truth of the doctrine taught long ago by the late Dr. Graves, that cholera travels along the highways of human intercourse, carried from city to city and from country to country, as the case may be, in the caravan, in the crowded ship, in the coach in the olden time, or in the railway carriage in our own day. Before us we have a map on which is shown the route by which it reached Ireland on its last visitation.

In the beginning of the year 1864 every part of the world was free from cholera except Bengal. The disease had died out except in its endemic area, but during that year it spread through Central India and into the Bombay Presidency. There are several places in India to which, at certain seasons, vast numbers of the natives journey from great distances; at some of them fairs are held, to others they go on pilgrimages. Into these assemblages cholera was introduced by those who had come from Lower Bengal, and when the gatherings had broken up the individuals who had contracted the disease carried it with them to their native towns, and so it was found that in 1865 cholera prevailed as a severe epidemic in Bombay. Between Bombay and the Southern Coast of Arabia there is constant commercial intercourse, and in March, 1865, cholera was raging at Mokalla and Mocha, to which it had been carried by native traders from Bombay. Now, this year, 1865, was one of special importance in the Mahometan calendar, and during the early summer devout Mahometans set out from every country in which that faith prevails on a pilgrimage to Mecca and Medina; they came from the East, from India



Forster & Co. Lith, Crow St. Dublin

and China, and the Indian Archipelago; they came from the West, from Turkey, and Egypt, and assembled to the number of 90,000 around the holy cities. Among the vessels which conveyed them were two, the *Persia* and the *North Wind.* These ships came with pilgrims from Singapore, and after calling at Mokalla disembarked their passengers at Djeddah, the port of Mecca; but between Mokalla and Djeddah cholera appeared among the passengers, and with them it found entrance into the assemblage of pilgrims around Mecca. These unfortunate people were living under conditions in the highest degree favourable to the spread of any pestilence; they were crowded together, very scantily supplied with water, and surrounded by every kind of filth, and by the remains of the animals which had been sacrificially slaughtered. It is believed that 30,000 persons died, and those who were left hastened away from the plague-stricken encampment. As I have already mentioned, many of the pilgrims came from Turkey and Egypt, and on May 19th the first ship with returning pilgrims reached Suez; many of the passengers had died of cholera during the voyage, the others were immediately conveyed by rail across the isthmus to Alexandria, where they encamped outside the town. The condition of Alexandria and its environs at this season was eminently favourable to the multiplication and diffusion of the *contagium* of cholera. In a less degree Lower Egypt presents the same features as Lower Bengal. It is the delta of a great river; it is exposed to an almost tropical sun; its vegetation is luxuriant and its inhabitants are uncleanly. Here cholera broke out and prevailed with great severity. The port of Alexandria too is the place of all others in which the greatest facilities exist for the rapid diffusion of any pestilence. In it you may see every day the flag of almost every European nation. It is the great highway between Europe and the East, and from it are daily starting English, French, Russian, and Austrian steamers. The first case of cholera occurred at Alexandria on June 2; on June 11 it was at Marseilles, on June 28 at Constantinople, and on July 7 at Ancona. Considerable precautions were adopted to prevent its entrance into English ports, and it did not appear at Southampton until September 17; it did not spread there nor did it come to Ireland by that route. We have now reached the autumn of 1865. During the autumn and the ensuing winter it prevailed in various parts of northern Europe; it had found its way there by two roads; from Constantinople it had spread along the shores of the Black Sea and up the Danube, and by a totally different

path it had gained access to the very heart of Europe. Not a few of the pilgrims who fled from Mecca were Persians, and they journeyed homewards along the coast of Arabia and up the Persian Gulf; they carried the cholera with them up the Gulf, along the valley of the Euphrates, to the shores of the Caspian Sea, and hence it was soon carried into Russia. Reaching northern Europe by both these routes in the spring of 1866 it prevailed extensively in Holland, and on May 2 two persons who had just arrived from Rotterdam died of cholera in Liverpool; and, beginning in the streets inhabited by the Dutch and other foreign emigrants and sailors, cholera spread through various parts of Liverpool. On July 26 a girl died of the disease in Dublin, and on investigation of the case by Dr. Mapother it was discovered that she came from a Liverpool lodging-house frequented by these sailors.

The ARCTIC Disease Realm extends from the isothermal line of 41° Fahr. to the poles. In the countries lying in this region there exist many conditions unfavourable to health; extreme lowness of temperature and dampness are among the most powerful; in this region vegetation is less rapid and luxuriant, and the great body of the people have a less abundant supply of food; nor must we omit the long nights and short days and deficient sunlight from which those countries which approach the poles suffer.

The lowness of temperature indeed is not an unmixed evil, for it is eminently unfavourable to the spread of zymotic diseases, which, in consequence, seldom prevail in the Arctic realm. It is from constitutional diseases that the inhabitants of countries within this realm chiefly suffer; the conditions under which they live are unfavourable to long life or vigorous health, and they suffer in consequence from scrofulous diseases, and other diathetic diseases characterized by a low standard of vital action.

Between the torrid and the arctic disease realms lies the TEMPERATE, in which our own land is situated. The diseases met with in this realm will be largely discussed, I have no doubt, in the subsequent lectures of this course; they are due less to the climate in which the inhabitants of this region live than to their habits—to the artificial life they lead and the various unfavourable conditions imposed upon them by the crowding and the struggling for existence in our great towns, and the still more unfavourable influence exercised by their vices. The deadly miasm of the tropical jungle does not kill more surely, the bad food and sunless winter of the polar regions do not lower the standard of

health and shorten life more certainly than does intemperance, which, in these lands, at the present day, prevailing as it does, among rich and poor, seems likely to inflict a blow on England's greatness more deadly by far than any we could receive from pestilence or war. Zymotic and diathetic diseases are to be met with in about equal proportions in this the temperate disease realm; among the former we have typhus fever, the crowd-fever of the poor, and typhoid fever—a malady which seems very intimately connected with the extensive system of sewerage which the arrangements of our modern houses require, and is hence as commonly, nay more commonly, met with in the mansions of the rich and the comfortable homes of the middle classes than among the very poor; it is the fever which is endemic in many of the large continental towns, such as Naples and Geneva, and which in these cities not unfrequently causes the death of English tourists, who, coming freshly under the influence of the miasm, are specially liable to be affected by it. Conspicuous among the diathetic diseases we have consumption—a malady which is the expression of a low state of vitality, however induced, but which recent observation has shown to be in a great degree preventable; investigations carried on in England, under the direction of the medical officer of the Privy Council, have brought to light the fact that the mortality from consumption stands in a very constant relation to the dampness of the soil, and that where effective drainage has diminished this the mortality from comsumption has, in proportion, been lessened. In Salisbury the consumption death-rate has diminished one-half since the town was thoroughly drained.

The subsequent lectures of this course will, if I mistake not, impress strongly upon you this fact, that it is not only the duty but the interest of the rich to care for and to seek the health of their poorer neighbours; you will learn how the fever which is bred in the lanes and alleys of our city creeps into the broad streets and open squares, and the facts I have mentioned teach the same lesson. I have shown you how the pestilence, which finds the conditions necessary for its permanent existence in the undrained swamps and filthy villages of England's great dependency, travels thence until it reaches the busy hives of English industry and gathers its victims from the mansions and homesteads of Britain itself.

V.—*On Zymotic and Preventable Diseases.* A Lecture by THOMAS W. GRIMSHAW, Esq., M.D., Fellow and Censor of the King and Queen's College of Physicians in Ireland; Physician to Stevens' Hospital, and the Fever Hospital, Cork-street, Dublin.

THE subject which I have selected for this lecture is a large one—so large that it is scarcely capable of being treated with sufficient depth to make it interesting without being made dull or abstruse from the close condensation of the large number of facts, theories, and suggestions which I shall have to pass in review in the short space of time at my disposal. Fortunately, those who have gone before have cleared the way for me, and I have no doubt that those who will follow in this course of lectures will fill up the many vacancies which I shall have to leave in this discourse. The title of this lecture is "Zymotic and Preventable Diseases"; and I have chosen it with a view of indicating, as closely as a title possibly can, the nature of the subject I have to refer to. I do not propose to discuss all the diseases which might be included among the preventable, or more correctly, the controllable class, but only such as come under the head of "Zymotics," and therefore more immediately affected by public measures of prevention, and by the conditions which affect large communities. A certain class of diseases, namely, those owing to unhealthy trades are certainly controllable, but will be discussed in the lecture to be delivered by Dr. Mapother. In the first place, I will give you an idea of what I consider to be a preventable disease, and with that view I shall define it as any disease which arises or spreads in consequence of the wilful or careless violation of the laws of nature, which we know it is necessary to observe to insure the preservation of health or prevent the spread of disease. I must also point out the nature of some of these laws of health, and show the result of their violation. Some persons have objected to the term "preventable" being applied to any disease, believing conscientiously that diseases are a direct visitation of God upon his people for his own wise purposes and their benefit. I most heartily concur in this opinion, for if ever direct judgments fall upon mortals for

sins committed, there can be no better examples than those derived from the terrible disasters which have so often followed the wilful or careless violation of the sanitary laws of nature, or, as I prefer to call them, the sanitary laws of God. I say, therefore, with all humility, that the term preventable, as applied to diseases, is in no way impious. Unfortunately, those diseases which are produced by personal and private bad habits are beyond the immediate control of public measures, and are outside the scope of this lecture.

Of these diseases Dr. William Farr remarks:—

"It is here that the various forms of plague are found which experience has shown are influenced to a large extent by sanitary conditions, thus small-pox is diminished by vaccination, enteric fever by sweetness of air, typhus by ventilation, erysipelas (St. Anthony's fire) by cleanliness, metria (puerperal fever) by isolation of mothers, diarrhœa and cholera by the exclusion of sewage from waters in domestic use."

Now, what do I mean by Zymotic diseases? The term Zymotic has been adopted by those who believe that in these diseases a peculiar pathological process goes on allied to if not identical in nature with fermentation, as observed outside living bodies, this fermentation results in the production of that peculiar train of symptoms characteristic of each one of these diseases. I cannot here enter into the proof or disproof of this theory of Zymosis; but I may state that I believe it to be the true foundation of the pathology of these diseases, and, up to the present, the only one which offers to my mind a reasonable explanation of the phenomena which attend their development, propagation, and results.

I use the word Zymotic only as a term used by the Registrar-General in his returns to signify those diseases commonly known as contagious febrile affections, together with a few other forms, which are not usually accompanied with febrile symptoms, and a few others which may not be, or are but slightly contagious. The chief diseases of this class are Fevers, Diarrhœa, Scarlatina, Small-pox, Whooping-cough, Cholera, Measles, Erysipelas, Metria (or Puerperal Fever), Croup, Diphtheria. There are some others less important, but these are sufficient to show the nature of the class, and their names are, I fear, but too familiar to most of you. We must consider them from several points of view:—

1st. The damage they inflict upon us.
2nd. The conditions under which they spread.
3rd. The conditions under which they arise.
4th. The means suggested for their control.

First,—The amount of danger done to us is immense. Thus from a return ordered by the House of Commons, on the motion of Mr. W. H. Smith, M.P. for Westminster, we find that of the 3,249,077 deaths which occurred in the United Kingdom during the five years 1865 to 1869 inclusive, 712,277, or 21·9 per cent. were caused by Zymotic diseases, in other words, about 1 in every 5 of the deaths is caused by a disease of this kind, and we lose at the rate of about 150,000 people annually in the United Kingdom from Zymotic diseases. The deaths were distributed between the three countries in the following proportions:—

England—111,418, being ¼ of the total mortality, or 1 in 190 of the population.

Scotland—16,193, being ¼ of the total mortality, or 1 in 194 of the population.

Ireland—18,416, being ⅕ of the total mortality, or 1 in 308 of the population.

From this we see that Ireland, with all her sanitary defects, is better off than the sister countries in this respect, and I believe this is owing to the energetic efforts of the well organized though badly paid system of Poor Law Medical Service, of which we have had so long to boast of in this country. When to this organization is committed the duty of preventing as well as curing disease, we may expect a still further reduction in the mortality from these diseases.

The deaths in Ireland from the principal Zymotics in the five years thus mentioned were—

Fever, . . .	21,895,	or at the	rate of	4,379	per annum.
Scarlatina, .	16,474	,,	,,	3,295	,,
Diarrhœa, . .	10,081	,,	,,	2,016	,,
Whooping-cough,	9,475	,,	,,	1,895	,,
Small-pox, .	1,553	,,	,,	314	,,

From this table it appears that by far the most serious of these Zymotics are such as are always amongst us—1st, Fevers, 2nd, Scarlatina. I shall presently show more fully that the constantly present Zymotics are far more serious than those which only annually visit us, such as Cholera, Small-pox. While these latter quickly sweep away large numbers, thereby striking us with terror, the former gradually and silently eat away thousands without much notice being taken of the effect produced by them. Let us see how these epidemics affect our city of Dublin. The total number of deaths in Dublin since the Registration Act came into force in 1864, up to the end of last year, 1872, was

73,661, or a weekly average of 157; of these, Zymotic diseases caused 17,156, being 22·6 per cent., and equal to a weekly average of 36·5. These were distributed as follows among the various Zymotics in order of their numbers:—

	Total.	Rate per annum.
Fevers, ...	3,506	389
Diarrhœa, . . .	2,576	286
Scarlatina, . . .	2,407	267
Small-pox, . . .	1,699	188
Whooping-cough, . .	1,464	162
Cholera, . . .	1,293	143
Measles, . . .	1,124	124

The balance is made up of several others less destructive, but probably not less controllable (see Diagram IV.)

This is farther shown by a comparison of the admissions into the Dublin Fever Hospitals, as seen in Table I. and accompanying diagram. These hospitals take in all kinds of Zymotic diseases, and although a number of other acute diseases not of the Zymotic class gain admission, yet those may be fairly set against the considerable number of Zymotics admitted into the general hospitals, so that Table I. fairly measures the prevalence of Zymotic diseases in Dublin for the 15 years ending March 31st, 1871; but of course only represents a portion of the cases, perhaps a large portion of the worst cases, but scarcely any of the mild ones. The great bulk of the cases here tabulated in Table I. consist of Fever. On inspecting the table, it will be seen that, commencing with the year 1857, when the Board of Superintendence furnished the first Report, the admissions fell until the year 1859, when they rose again for one year (1860), then fell again for one year (1861), to rise again continuously until 1866, when the number of admissions reached 3,562; in this year cholera also prevailed, and that disease is included in the Hardwicke Hospital Returns to the number of 187. Cholera was not admitted into Cork-street Hospital.

Zymotics, especially fever, prevailed to a greater extent in the year 1866 than it has done at any time during the period under consideration; the numbers in Cork-street on one day reached 185, these being nearly all typhus cases. From 1866 (year ending 31st March, 1867) fever steadily decreased until the year 1869, when the admissions reached but 1,823. It has, however, been since rising, the admissions being 2,264 and 2,343 respectively, for the two years ending March 31st, 1871. It will thus be seen that the rate of ad-

missions to the Fever Hospitals was much the same during the year ending March 31st, 1871, as it was ten years ago.

The total number of admissions were 42,534.

TABLE I.—Showing the ADMISSIONS into the CORK-STREET FEVER HOSPITAL, and the HARDWICKE FEVER HOSPITAL, from the year ending March 31st, 1857, to March 31st, 1871.

Year ending	Admissions into Cork-street Hospital.	Admissions into Hardwicke Hospital.	Total Admissions.
(1)	(2)	(3)	(4)
March 31st, 1857, ...	1,606	1,705	3,311
" 1858, ...	1,466	1,626	3,092
" 1859, ...	1,310	1,609	2,919
" 1860, ...	1,616	1,430	3,046
" 1861, ...	1,478	1,174	2,652
" 1862, ...	1,700	1,129	2,829
" 1863, ...	1,845	1,179	3,024
" 1864, ...	1,747	1,405	3,152
" 1865, ...	2,086	1,249	3,335
" 1866, ...	2,151	1,411	3,562
" 1867, ...	1,774	1,379	3,153
" 1868, ...	1,098	931	2,029
" 1869, ...	965	858	1,823
" 1870, ...	1,270	994	2,264
" 1871, ...	1,357	986	2,343
Total, . . .	23,469	19,065	42,534
Average, . . .	1,564	1,271	2,835

I have shown what a large proportion of the death-rate is caused by Zymotic diseases, namely, one-fourth in England and Scotland, and one-fifth in Ireland, or, more exactly, 21·9 per cent. of the total mortality of the United Kingdom. The chief portion of these deaths is concentrated in the large towns, and is the chief cause of the town death-rate being in excess of the country death-rate. From this we may conclude that the variations in death-rate in large towns will follow very closely the variations in prevalence of Zymotic disease; and the relations in death-rate between different towns will also closely follow the relative prevalence of Zymotic disease. This is well demonstrated in the accompanying tables and diagrams, showing the relation between the variations in death-rate from Zymotics in Dublin, as compared with that of the total death-rate, and the relation between the Zymotic death-rate in large towns, to the total death-rates.

On looking at Diagram I. representing, for the past nine years, the relations between total deaths in Dublin, total

deaths from Zymotic diseases, deaths from fevers, as a specimen of the result of endemic diseases, and deaths from cholera in 1866, and small-pox in late epidemic as specimens of the results of the only two great epidemics which occurred during this period, it will be evident that, with few exceptions, the variations in the Zymotic deaths correspond very closely with the variations in total deaths. The chief exceptions may be easily explained, and have already been referred to by Dr. Moore; they depend upon the effect of cold, especially intense cold, increasing the deaths from chest diseases to an enormous extent. The best example of this was the intense cold which followed the subsiding of the cholera in 1866, and the cold of the beginning of 1871, specially mentioned by Dr. Moore, for, after the cholera had subsided, the great cold of January, 1867, raised the death-rate higher than it had reached during the height of the cholera epidemic. You see that the curve representing the total deaths is accompanied by one representing the average weekly deaths for the corresponding periods, and we see that, with very few exceptions, where the total death curve rises above the weekly average, that it corresponds with a rise in the Zymotic curve, excepting always the increase owing to great cold, which can easily be corrected by observing the depressions in the curve of weekly mean temperature added to the diagram by Dr. Moore. Again, if we arrange the following large towns according to their death-rate, placing the one with the lowest death-rate at the top of the list, and in a parallel column arrange the same towns according to the death-rate from Zymotic diseases, we shall find a close correspondence:—

TOTAL DEATH-RATE.	ZYMOTIC DEATH-RATE.
1 Birmingham,	1 Bristol,
2 Hull,	2 Hull,
3 London, Bristol,	3 Birmingham, Leeds,
4 Dublin,	4 Edinburgh,
5 Sheffield,	5 London,
6 Edinburgh,	6 Dublin,
7 Leeds,	7 Sheffield,
8 Newcastle-on-Tyne,	8 Liverpool,
9 Salford,	9 Manchester and Newcastle
10 Manchester,	10 Glasgow,
11 Liverpool, Glasgow.	11 Salford.

Hull is the only one where this correspondence is exact, it standing 2nd on both lists. You may also see that although Bristol stands highest as being most free from Zymotics, yet

it is 3rd in the death-rate list; Birmingham being first on this list, and 3rd on the Zymotic list. The cases of Birmingham and Bristol I shall refer to again. Dublin, though tolerably high in the death-rate list, is about average so far as Zymotics are concerned.

A reference to Table II. and Diagram II., constructed to show the relations between total death-rate, Zymotic death-rate, and density of population, in the 13 large towns referred to, will also show a marked amount of parallelism between the curves representing the Zymotic and total death-rates; Bristol being a well marked exception, and this exception is to be altogether attributed to the extensive measures undertaken to improve the sanitary condition of the city, and to maintain the public health.

Table II.—Showing the relation between density of Population, general Death-rate, and Death-rate from Zymotic Diseases in 13 large Towns of the United Kingdom, as shown in Diagram II.

Towns.	Population per Acre.	Deaths per 1,000.	Deaths per 1,000 from 7 principal Zymotics.
London,	41·8	24·2	4·5
Bristol,	37·0	24·2	2·0
Birmingham,	48·3	23·4	3·6
Liverpool,	103·0	31·1	5·6
Manchester,	84·5	30·4	6·0
Salford,	23·9	28·5	7·5
Sheffield,	11·2	26·5	4·6
Leeds,	12·3	27·2	3·6
Hull,	38·0	24·1	2·8
Newcastle-on-Tyne,	25·5	28·0	6·0
Edinburgh,	40·6	26·9	4·0
Glasgow,	94·3	31·1	6·4
Dublin,	33·1	25·4	4·4
Total,	45·6	25·8	4·7

In 4 towns the density of population above average.
In 3 of those mortality is above average; in 1 below—Birmingham.
In 3 the Zymotic mortality is above average; in 1 below—Birmingham.
In 9 the density of population is below average.
In 5 of those mortality is above average; in 4 below average.
In 2 of those Zymotic mortality is above average; in 7 below average.

The same proposition that Zymotic death-rate has a nearly constant relation to total death-rate is also shown by a comparison of the 28 districts of the London Registration Division for the year 1870, as shown in Table III. and Diagram III., constructed on the same principle as that for the 13 large towns mentioned above.

TABLE III.—SHOWING the Relation between Density of Population, General Death-rate, Death-rate from ZYMOTIC DISEASE, and Pauperism, in the London Registration Districts, as shown in Diagram III.

District.	Population per Acre.	Total average Death-rate per 1,000 for 10 years.	Death-rate per 1,000 from 7 Zymotics, 1871.	Paupers per Population in London District receiving Out-door Relief, 1871.
Kensington, . . .	89·3	19	4·5	1 in 36·9
Chelsea, ...	82·2	25	6·6	" 47·0
St. George's, Hanover-sq., .	74·1	19	4·9	" 30·2
Westminster, . . .	235·7	23	4·2	" 40·1
Marylebone, . . .	105·4	24	4·2	" 41·0
Hampstead, . . .	14·3	17	4·4	" 122·2
Pancras, ...	81·5	22	4·8	" 25·5
Islington, ...	68·0	21	7·2	" 42·2
Hackney, ...	31·7	19	3·8	" 20·7
St. Giles', ...	217·0	28	4·7	" 36·7
Strand, ...	97·2	22	4·2	" 34·5
Holborn, ...	205·2	26	4·1	" 21·9
London City, . . .	104·6	19	4·0	" 13·9
Shoreditch, . . .	196·8	26	6·1	" 30·4
Bethnal Green, . . .	158·2	23	5·0	" 32·4
Whitechapel, . . .	185·6	28	4·6	" 22·8
St. George's-in-the-East, .	198·8	29	5·5	" 11·9
Stepney, ...	99·9	27	4·2	" 19·3
Mile End, Old Town, .	136·8	24	4·7	" 29·0
Poplar, ...	39·4	24	4·5	" 25·6
St. Saviour's, Southwark, .	151·3	29	4·9	" 22·6
St. Olave's, Southwark, .	69·4	29	4·4	" 30·9
Lambeth, ...	51·8	23	5·3	" 32·2
Wandsworth, . . .	10·7	20	5·3	" 27·4
Camberwell, . . .	25·6	23	3·6	" 30·6
Greenwich, . . .	26·6	24	5·2	" 21·7
Lewisham, . . .	4·5	18	4·2	" 12·6
Woolwich, . . .	9·9	–	6·7	" 44·4
Average, . .	41·8	24·2	4·4	1 in 27·8

From an analysis of the tables from which these curves are constructed, we find that of the 13 large towns enumerated the death-rate is above average in 8, and of these 8 the Zymotic death-rate is above average in 5, nearly at average in 1, below average in 2, and of those where the death-rate is below average, the Zymotic death-rate is never above average, and nearly up to average in but one case only.

I have thus shown what a large number of lives are lost owing to this class of diseases, and especially owing to those to which I have especially referred; also what an influence Zymotic diseases have on the total death-rate, especially that of large towns. Besides the absolute loss of life—to this loss of life from preventable disease the term "*life waste*" has

been applied by my friend Dr. Maunsell, a high authority on the economic relations of disease and pauperism—the money loss is immense to the community besides to individuals. Thus the small-pox, the most severe epidemic that has visited Dublin this century, except the great fevers of 1826, and famine fever of 1847, and cholera epidemic of 1832 and 1849, cost Dublin not less than £35,000, probably £40,000, for the treatment of the sick. Nearly the whole of this was spent on hospital appliances, food, medicine, and stimulants for the sick, the medical attendance costing a mere trifle, probably not £1,000 for poor law medical relief. Besides this, there was great loss to the trade of the city. The records of the Mansion House Small-pox Relief Committee show the incalculable amount of misery caused by epidemics. These show that the applicants for relief represented 6,000 persons who were affected by small-pox, and who were reduced to apply for relief on account of the loss caused by the disease to them and their friends; 667 heads of families suffered, 179 heads of families died.

None but clergymen and medical men know of the wide-spread anguish caused by this terrible visitation. The clergy of all denominations were morning, noon, and night passing from house to house, and bed to bed, comforting the sick and dying, the widows and orphans. We members of the medical profession had to visit our hospitals not only once but twice, and often thrice daily; the dispensary medical officers spent their whole time in the dens of this noisome pestilence. As an example of the amount of work thrown upon us by this terrible but preventable disease, there fell to my share within a few of 600 cases, and other members of the profession had to deal with perhaps larger numbers. With such an example as this almost present before our eyes, it is unnecessary to look for other illustrations from more remote or less striking evils; Dr. Stokes has already described to you the terrible results of the famine fever of 1847. After what I have said, and from the important place that small-pox and cholera occupy in Diagram I., you will perhaps be surprised to hear that such epidemics are but secondary in their destructiveness; they are more sharp and decisive, but other diseases such as fever, scarlatina, measles, and diarrhœa, do their work of destruction quite as surely, only creating alarm where they rise with epidemics, as indicated in the diagram where their names were introduced between the zymotic and fever cases. Let us compare the relative amount of damage done by these various zymotics in Dublin during the space of nine years, while there has been a

systematic registration of deaths in Ireland. This is shown by diagram IV. and the following table:—

	Total for nine years.	Average rates per annum.
1. Fevers, . . .	3,506	389
2. Diarrhœa, . . .	2,576	286
3. Scarlatina, . .	2,407	267
4. Smallpox, . . .	1,699	188
5. Whooping-cough, .	1,464	162
6. Cholera, . . .	1,293	143
7. Measles, . . .	1,124	124

From this you will see that fever is by far the most destructive, and the per-centage of deaths of those attacked being low, the 3,506 deaths represent an enormous number of cases, probably not less than 50,000 severe cases. As fevers are chiefly fatal to adults, while scarlatina, measles, diarrhœa, and whooping-cough are chiefly fatal to children, it is evident that the relative misery and loss produced by fever is greater than any of the other zymotics, and I wish especially to insist on this point that the endemic zymotics constantly among us, any of which may assume the epidemic form, are far more destructive than those which only appear as epidemics; and however much it may be our duty to ward off cholera and small-pox from our shores, yet it is equally our duty, and far more important for our national prosperity and domestic comfort, that we should control these endemic diseases which never die out. The foregoing statements refer not only to Dublin, but to nearly, if not to all, large towns. As I have shown by the diagram how much zymotic death-rate influences the general death-rate, so I can here show how much the fever death-rate influences the zymotic death-rate, and therefore influences the general death-rate more fatally than any single disease, except consumption.

If you look at the curves on diagram I. you will see that the elevations and depressions of the zymotic curve correspond almost invariably with elevations in the fever curve, although zymotics are sometimes high when fever is low, as seen in the diagram, where the various other zymotics which, together with fever, went to make up the total zymotic mortality, are marked between the zymotic and fever lines. There was but one week during the whole nine years represented on diagram I. in which no deaths from fever were registered. There are good reasons why this correspondence should exist, as I shall show when I discuss the conditions under which zymotic diseases spread.

Conditions under which Zymotic Diseases spread.

The conditions which influence the spread of zymotic diseases are numerous, but are easily classified; they belong to one of two great classes—those belonging to places, or those belonging to persons or population.

A. Those belonging to place—

1. Locality, whether high or low, elevation, and geological formation of ground on which it lies.
2. Facilities for drainage and water supply.
3. Age, condition, and construction of streets and houses.
4. Climate.

B. Those which belong to population—

5. Density of population.
6. Proportion of pauperism.
7. Cleanliness of inhabitants.
8. Accommodation for the sick.

Locality.

It is a well established fact that the higher the situation above the level of the sea the less the prevalence of zymotic diseases; this no doubt is chiefly owing to the facilities afforded by such situations for efficient drainage, and also to the fact that few large communities are so situated. As, however, the situation of all our towns and most of our villages has already been settled, we may almost leave this consideration out of the question. Their position can scarcely be at all effected by public measures, but the defects in situation may be counteracted to a great extent by sanitary measures. As an example of the effects of situation, Birmingham, which from its elevated position, porous soil, and favourable aspect, has a system of natural drainage, although densely populated and without any particularly good sanitary system, is the healthiest of the large towns in the United Kingdom, usually escapes great epidemics, and has a low zymotic death-rate.

Drainage and Water Supply.

The great effect of proper drainage and water supply on the health of towns is shown by the instances given in the accompanying table IV., taken from the Ninth Report of the Medical Officer of the Privy Council, from which it appears that a large number of English towns have been materially

improved in the health of their population by extensive improvements in drainage and water supply; endemic diseases have permanently diminished, and epidemics have fallen with lightness on these towns since the improvements have taken place. This is especially and almost invariably to be noticed in enteric fever, diarrhœa, and cholera, the only diseases I considered necessary to include in my tables.

This table shows the result in ten of the largest towns enumerated in the report, several others, however, have undergone similar improvements by similar means.

Age, Condition, and Construction of Houses.

It is a notorious fact that old houses in old streets of old towns are the favourite haunts of zymotic disease, and there are other reasons for this besides the age of the houses, for it is here that we find poverty, hunger, and dirt, combined with overcrowding, all of these being promoters of zymotic disease. A comparatively new house may, too, from faults in original construction, want of drainage, and neglect of repairs and cleaning, become as bad as any old house.

I have constructed from the records of the Cork-street Fever Hospital a list of all the houses on the south side of this city, from which cases of fever were admitted into the hospital during a period of two years ending September 30th, 1871. These houses are marked on this map by red dots.* Two lines intersect the map, and the point of intersection marks the centre of old Dublin as it existed in A.D. 1610; the boundary of the city at this date is also marked on the map, and the boundary of the city in 1728. A glance at the map will show that by far the greater number of fever dots are concentrated in the area of the old city, the remainder being nearly contained between the boundaries of 1610 and 1728, the next oldest part, and but few are situated beyond the latter line or modern part of the city. I have traced out 1,190 of these fever houses; of these there were 122 especially productive of fever, and of these 122 no less than 70 are within the old city boundary. The worst fever streets in Dublin are to be found among the oldest, thus, Francis-street which was fully built in 1610, has 28 infected houses out of 140. The Coombe, though not so old, and Meath-street more modern still though old, are remarkably productive of fevers. The same may be said of the old streets lying along the bank of the river, though not on the line of

* An ordnance map with these and other markings mentioned in the lecture was exhibited at the time of its delivery.

TABLE IV.—ILLUSTRATING the Improvements of PUBLIC HEALTH resulting from Proper Works of Drainage and Water Supply.

Population in 1861.	Name of Town and order of Population.	Periods for which comparisons were made.		Deaths per 10,000 for each period compared.							General Death Rate.	
				Enteric Fever.		Diarrhœa.		Cholera in each of Three Epidemics.				
		Before Works.	After Works.	Before Works.	After Works.	Before Works.	After Works.	1848-9.	1854.	1866.	Before.	After.
160,714	Bristol, . . .	1847–50	1862–5	10	6·5	10·5	9·5	32	11	1·5	245·5	242
68,056	Leicester, . . .	1845–51	1862–4	14·6	7·7	16	19·3	1	10	–	264	252
52,778	Merthyr, . . .	1845–55	1862–5	21·3	8·6	11·5	6·2	267	84	20	332	262
39,693	Cheltenham, . .	1845–57	1860–5	8	4·7	8·3	7	–	–	–	194	185
32,954	Cardiff, . . .	1847–54	1859–66	17·5	10·5	17·2	4·5	208	66	15·5	332	226
30,229	Croydon, . . .	1845–50	1857–64	15	5·5	10	7	27	21	2	287	190
29,417	Carlisle, . . .	1845–53	1858–64	10	9·7	11·3	12·5	22	6	–	284	261
27,475	Macclesfield, . .	1845–52	1857–64	14·2	8·5	11·3	11	9	1	–	298	237
24,756	Newport, . . .	1845–49	1860–65	16·3	10·3	11	6·5	112	1·5	12	318	216·5
23,108	Dover, . . .	1843–53	1857–65	14	9	9·5	7	40	10	4·7	225·5	209

our modern quays. In old times there was no "north side" of Dublin except a small portion around St. Michan's Church and the Abbey of St. Mary, and following the rule I have laid down, these are the worst fever streets on the north side of the city. Now why have I said so much about the localities where fever prevails? because I have ascertained that these also are the places where *all* zymotic diseases arise and spread; thus a cholera map or a small-pox map would be precisely the same as this fever map; the same streets would be in the same colours, and many of the same houses would be marked in both; thus, of 124 fever nests, 58 at least have been also small-pox and cholera nests. This is not true only of Dublin but also other large towns as was shown in the *Lancet* report on "Cholera Haunts and Fever Dens of London," and Dr. Gairdner's remarks on the fever dens of Glasgow point to the same conclusions; but it is unnecessary to go out of our own city to find proof of this. On again referring to the map it will be seen that a number of circles are drawn round certain localities. These represent especially infected places, which are the constant habitats of fever and diarrhœa, and where I have ascertained that cholera and small-pox have prevailed in the last two epidemics—in some instances even in the epidemic dating as far back as the cholera of 1832. I may here describe by extracts from my paper on the "Prevalence and Distribution of Fever in Dublin," and from the report of the Dublin Sanitary Association, the conditions we find in these fever streets and houses:—

"The streets are generally characterized by being composed of old—many of them once fashionable—houses, with bad rears, or no rears at all. It is not essential, as many suppose, that fever streets should be narrow and tortuous; on the contrary, two of the worst fever streets, Meath-street (the very worst), and Francis-street, are wide and straight. It is the age and condition of houses, and proximity of narrow courts and alleys, that especially characterize these streets, together with the want of proper house drainage, ash-pit, and privy accommodation for the houses themselves. As examples of the worst fever streets, I may mention Meath-street, with its 95 houses, 36, or more than a third, of which furnished in all 73 cases of fever to Cork-street Hospital during the two years; it contains one fever-nest furnishing 6 cases, and 10 others furnishing 3 or 4 cases each. Francis-street, with 140 houses, has 28 fever houses, furnishing 55 cases, has in it two fever-nests furnishing more than 5 cases, and 6 houses furnishing 3 or 4 cases each. The Coombe contains 129 houses, has 46 fever houses, furnishing 78 cases, one house furnishing 5 cases, and 4 others furnishing 3 or 4 cases each. These are sufficiently detailed ex-

amples of fever streets; but I could mention many others nearly, though not quite so bad. The lanes and alleys are probably worse than the streets, but must be merely looked upon as streets on a smaller scale. The courts (comprising yards and squares) are next to be considered. These are, perhaps, the most prolific fever beds, as few of them have failed to produce fever cases during the past two years. Fever streets are generally skirted by these courts, notably those which I have already given as special examples of fever streets. There are several kinds of courts—first, those originally constructed as such; secondly, lanes closed up at one or both ends, and entered by archways; and thirdly, back yards and gardens that have, by the cupidity of the owners, been built upon, and the out-offices converted into dwelling-houses, thus crowding together a large number of small tenements in a very confined space. These latter are generally known by the name of yards, and are usually designated by the number of the house behind which they are situated. Few people besides clergymen and medical men are acquainted with the existence of these places.

"Examples of the first form of court may be found in abundance off South Great George's-street and Kevin-street, and a considerable number in the neighbourhood of Townsend-street. They are, in fact, narrow, blind lanes, and have usually an open sewer running down the centre through the whole length, and emptying itself into the adjoining street, or into a trap near the entrance of the court. These traps are frequently choked, and large quantities of sewage accumulate. There is usually a privy, seldom more than one, situated in each of these, as also in the other form of courts; the drainage from this privy, of course, finds its way down the open sewer already described in the centre of the court. The square may be considered as the last of these forms of court, samples of which are Gill's-square, off Cole-alley, Neil's-court, off Marrowbone-lane, Derby-square, off Nicholas-street, &c. These squares have usually no drainage, and are surrounded by miserable old overcrowded houses, and are generally strewn with rubbish and filth, consisting, to great extent, of human ordure, and have one or two cess-pools near the centre. I have already indicated the nature of the yards, several of which may be found in Marrowbone-lane, Cork-street, and the Coombe. The houses in all these are of the most filthy character, and the front house or houses in the street usually indicate the nature of what is behind, having the usual characters of a fever-nest, which I shall presently refer to more particularly. The ground of all these courts is saturated with decomposing organic matter, chiefly human excrement."

The following is taken from the Report of the Dublin Sanitary Association:—

October 4th, 1872.

"*Nos.* 17 *and* 18, *Great Ship-street,—Overcrowding—fever—* unfit for habitation in their present state.

"*No.* 17—*Basement Story* damp and filthy—sewage matter is said, at times, to ooze up through the flagging.

"In the kitchen			*front* 2 persons live.			
"	ground	floor	*front* 7	"	"	3 children sick.
"	"	"	*back* 4	"	"	—
"	first	"	*front* 8	"	"	1 person sick.
"	"	"	*back* 3	"	"	1 person sick.
"	second	"	*front* 5	"	"	—
"	"	"	*back* 5	"	"	—
"	top	"	*front* 5	"	"	—
"	"	"	*back* 1 person lives			—

"Total population consists of *forty* persons, *five* of whom are now sick, suffering chiefly from various forms of fever.

"*No.* 18—*Basement Story* uninhabited, but filthy. The population of the rooms is as follows:—

Ground floor—*front and back*—			4 persons.		
First	"	*front*	6	"	
"	"	*back*	5	"	
Second	"	*front*	8	"	
"	"	*back*	9	"	
Top	"	*front*	7	"	1 case of fever.
"	"	*back*	4	"	

"Total population is, therefore, *forty-three* souls. Total population of both houses, *eighty-three* souls, of whom *six* are now ill.

"In the rere of these two houses three cottages are situated.

"No. 1 is inhabited by a family numbering *five* persons, one of whom is ill of fever in Cork-street Hospital, and a second was to-day removed to the Meath Hospital, suffering from phthisis. (She died October 7th, 1872.)

"No. 2 has also *five* inhabitants—two of whom are now in fever—one in hospital, the other, a young child, at home. This, as the other cottages, is divided into two rooms by a wooden partition, not reaching to the ceiling. The total dimensions are 14 by 8½ by 11 feet, the space per head being only 262 cubic feet.

"No. 3 has *seven* inhabitants, two of whom are now suffering from fever in Cork-street Hospital. The father is in extreme danger, having an attack of severe maculated typhus. The rooms in this cottage are very dirty compared with those in Nos. 1 and 2.

"The total population of the holding 17 and 18, Ship-street, is exactly *one hundred* souls.

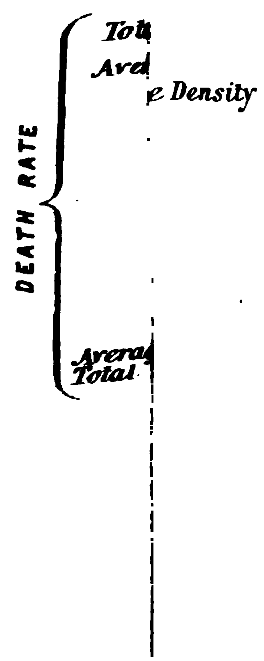
"The sanitary accommodation consists of a Vartry-water tap, two privies (each with *two* seats), in average order, and one large ashpit, which requires cleansing.

"Your Sub-Committee would call earnest attention to the formidable outbreak of fever which has taken place in these houses—

due, in a great measure, to the great overcrowding of the rooms, and to the defective sanitary condition of the basement storey of the houses. No less than 11 per cent. *of the population are at present stricken down by fever.*

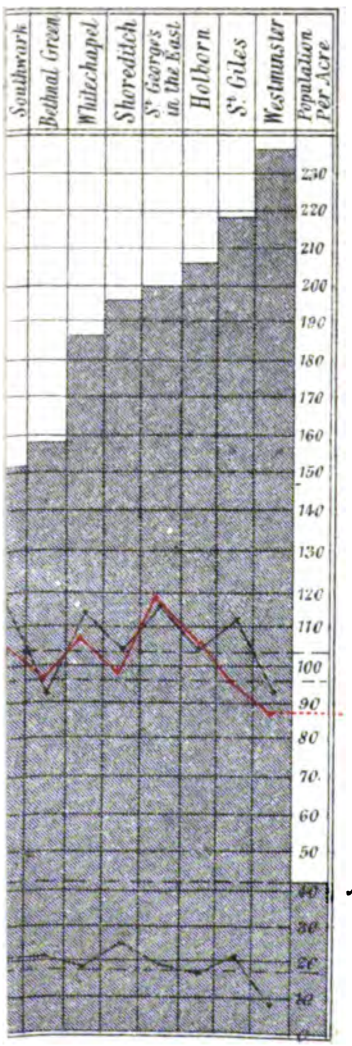
"These houses are built on the site of an old graveyard; they face the Ship-street Military Barracks, and a line of stables is situated to the south side of them."—*Report of Dublin Sanitary Association.*

"What are the characters of a fever-nest? The best way to answer this question is by describing one or two. I shall begin with the worst on my list, 58, Bridgefoot-street. This house is entered from the street by a passage, with a black and rotten floor, in which are open chinks communicating with the cellar below; the boards are damp and sodden with dirt. Going upwards, we find things somewhat better, but the whole upper part of the house is dilapidated. Going downwards, we first come to the entrance of a small back yard, a place covered ankle-deep with human filth, a privy and ashpit totally unapproachable without passing through a sea of dirt, a water-tap running, and washing such of the dirt as is within reach into a pipe sewer which runs through the cellar of the house, and which has a hole through which the sewage passes into the cellar, converting it into a cesspool; this cellar is immediately beneath two rooms inhabited by a family of fifteen, every one of whom has had enteric fever. In the same street I find another house with all these characteristics repeated, except the broken sewer, but this house had no sewer at all. A house in Chancery-lane furnished eight cases of fever (seven typhus and one enteric). I was met on entry by a horrible stench, proceeding partly from a filthy back yard, and partly from a slaughter-house at the rere of a neighbouring house in Bride-street. The cellar of this house had been filled up—a very proper measure, if rightly carried out; but the filling-up matters consisted of such material as to convert the cellar into a decomposing manure heap. The passage, back yard, and upper part of the house were similar to those already described at 58, Bridgefoot-street. I find similar conditions, varying only in degree, in almost every fever-nest. The less prolific fever-nests I find with less accumulated dirt, and notably less wet dirt. In many places where there was comparatively little dirt, what did exist was made to do the maximum amount of damage by being kept in a continual state of moisture, for want of proper drainage, or from drainage water from the roof or elsewhere running into the house by the doors, or through imperfectly closed cellar openings. These damp cellars, often nearly filled with rubbish, are to be found in all fever streets and most fever houses. Many houses have no receptacle for rubbish except the cellars; this is particularly true of corner-houses and houses near corners, many of which, if not public-houses, are fever-nests. Of the condition of these houses I may also state that a large



DEATH RATE
Tot
Ave
e Density
Avera
Total

principal Zymotic Diseases,
.tion District.



Average density of Population

number are condemned houses—that is, houses declared by the authorities as unfit for human habitation; but, through some evasion, or, in many cases, in open violation of the law, these houses are still inhabited, and frequently the occupiers even pay rent. I find that among my list of fever houses, there are fifty-two returned as bankrupt in the last report of the Collector-General of Rates; thus, the owners of these (who defy the tax-gatherer) and of the condemned houses, go free of the burdens of ordinary citizens, and claim as their privilege to spread disease and death at the expense of their honest, and, perhaps, not more prosperous neighbours."—*Prevalence and Distribution of Fever in Dublin.*

We next come to the conditions affecting the population themselves, as promoting causes of Zymotic diseases; and here we meet with great difficulties in the measurement of each of the various factors of density, poverty, and dirt of the population. We might expect that one—namely, poverty—would regulate the other two, but it does not altogether do so, although it is one of the chief regulators.

Density of Population.

Density of population seems to be the great promoting cause of Zymotic disease. This is shown by a comparison between the various London districts and between 13 large towns of the United Kingdom, as shown in diagrams II. and III. and tables II. and III. Of the 13 large towns—in 4 the density of population, as measured per acre, is above average; in 3 of these the death-rate is above average, and in these 3 the Zymotic death-rate is above average, the four being Birmingham, which is an exception to all such rules. Of the 28 London districts—in 20 the density of population is above average; in only 12 of these is the total death-rate above average, but in 17 out of the 20 (or 85 per cent.) the Zymotic death-rate is above average. This, I think, proves the connexion between density of population and Zymotic death-rate.

Pauperism.

That pauperism has also a considerable influence in promoting Zymotic diseases, may also be shown from the London districts; for in 12 of the 28 in which the pauperism was above average in 9 (or 75 per cent.) the Zymotic death-rate was above average—not so great as density of population, which gives 85 per cent. It is important here to show that the density of population and pauperism do not correspond; for in the 20 districts in which the density of population is above average, in only 8 is pauperism above average, and in 12 it is below. As might be expected, in these 8 both

pauperism and density of population increased the Zymotic mortality. Therefore, though density of population is not the exact out-growth of pauperism, yet where both are combined the Zymotics prevail to the greatest extent.

Cleanliness.

The next point is the effect of dirt in the promotion of Zymotic diseases; and that dirt has a large share in its propagation I have no doubt.

We cannot as yet certainly ascribe any particular kind of disease to any particular kind of dirt. The characters which I have described as pertaining to fever streets and fever houses are pretty well known to sanitarians, and these are the resorts of all kinds of Zymotic diseases, where dirt is the most prominent character. Now, what is dirt in considering it in connexion with disease? It will not do merely to say that "dirt is matter out of place"—an excellent definition, nevertheless. I do not mean mere personal dirt, but dirty air, dirty food, dirty drink, dirty houses, dirty clothes, and dirty persons, all combined; and these kinds of dirt mean *poison* for human beings, and manure for Zymotic diseases to flourish upon. The refuse of cowsheds and stables is dirt in a farm-yard, but it is food for the crops, and ends in being food for ourselves when, in nature's laboratory, it has been converted into bread and beef. Thus our domestic refuse is dirt when in and about our houses, or when it gets into our food or drink, or contaminates the air we breathe, but on the farm may be useful, for in the fields it is manure for the crops, but in the house is manure for the fertile growth of all Zymotic diseases.

I shall show you presently how dirt in air, water, and food, may and probably does cause, certainly promotes, special kinds of disease. Cleanliness, as contradistinguished from dirt, means the removal of all useless or injurious matters from our persons, dwellings, food, and drink, the principal means adopted for which purposes are washings and scrubbings; and if we admit—which I think few will have the hardihood to deny—that some diseases are promoted by contagion, it is manifest that in cleaning away dirt, we are removing the dirtiest though most minute of all dirt, the contagious particles of disease.

Accommodation for the Sick.

Another promoting cause of Zymotic disease is the want of proper accommodation for the sick, namely, proper and easily expansible hospital accommodation for all forms of contagious diseases, the want of proper means of bringing patients

thither, the want of proper means of disinfection and separation of the sick and convalescents from contagious Zymotics from the healthy. I regret to say that all these wants exist to a lamentable extent in this city.

In pointing out what are principal promoting causes of all Zymotic diseases, I think I have shown pretty clearly how epidemic Zymotic diseases attack favourite haunts time after time, and that these same haunts are the favourite habitats for fever and diarrhœa at all times. The President of the College of Physicians in the next lecture will, I believe, show you conclusively some of the ways in which these conditions make those subject to them liable to disease.

I now proceed to point out the origin of some of the more important of these Zymotics, or, more properly, to show what conditions seem absolutely essential to the production of them. There are many Zymotics which never seem to arise without contagion, although they flourish best on the soil prepared for them in the ways already described. It is not because we cannot always trace contagion that we are to deny its existence, as I think will be clearly proved by Professor Haughton. As the subject of contagion will be fully treated of by that eloquent Professor, it is quite unnecessary for me to refer further to it, but merely state that evidence of the introduction of the most alarming epidemics of cholera and small-pox through contagion is overwhelming, and it is scarcely necessary to say that overcrowding and dirt promote contagion. I have now to consider certain conditions which have appeared so constantly in connexion with outbreaks of certain epidemics, that they seem to be essential to the production of these diseases, and may therefore be put down as causes of disease. The best established of these are the production of cholera, diarrhœa and enteric fever, in connexion with water contaminated with sewage matter, and air polluted with sewage gas; also the causation of typhus fever by overcrowding. Besides these, we have it suggested, and substantial evidence given in support of the suggestions, that measles is produced by a miasma arising from decomposed vegetable matter, and that scarlatina is produced by decomposed blood and slaughter-house refuse.

But now, to consider these separately—

1st. Fevers.

Of these we have four kinds—simple, typhus, enteric, *i.e.* typhoid, and relapsing fever. The first appears to me to be

a mere attempt at one of the other two next, namely, typhus and enteric fever, but not sufficiently developed to be able to identify it with either. This being my opinion, I believe it may arise under the same circumstances, and accordingly I find that it nearly always prevails where there is typhus or enteric fever, but especially where typhus prevails, as appears from the following table of 42 houses furnishing more than five cases each in two years:—

13	houses	furnished	cases of	three kinds of fever.
19	"	"	"	simple and typhus.
4	"	"	"	simple and enteric.
4	"	"	"	typhus and enteric.
2	"	"	"	simple only.
0	"	"	"	typhus only.
0	"	"	"	enteric only.

Nineteen houses furnishing typhus, furnished also simple fever. The condition which seems necessary to the production of typhus is overcrowding, and although overcrowding favours the spread of all kinds of contagion, yet in no disease has it been so frequently and closely associated with the first appearance of disease as in typhus. Dr. J. Heysham (1781) traced an outbreak in Carlisle to a house inhabited by 6 families, and where no windows that could be built up were left open, consequently there was no ventilation whatever. Typhus began here without any trace of contagion, and then spread through the rest of the town. In 1859, typhus fever, which for some months had disappeared from Edinburgh, arose in a poor locality where the houses were overcrowded, and in no instance was there any suspicion of contagion.

"Important evidence in favour of the view that the typhus fever poison may be generated from overcrowding, may be derived from the various records of what have been termed 'Black Assizes,' where Judges, juries, and others in court contracted fever from the exhalations from the prisoners, who, in the days prior to the time of Howard, frequently suffered fearfully from what was termed 'gaol fever' in those days, but which was nothing more nor less than typhus produced by the overcrowding of gaols. The latest, therefore, most reliable account of a Black Assizes is that of 1750 at the Old Bailey, where 100 prisoners were tried. These were either placed at the bar or confined in two small rooms opening into the court. Many present were affected with a noisome smell. Within a week or 10 days, many of those present were seized with typhus. More than 40 persons died, including the Lord Mayor, two of the Judges, an Alderman, a Sub-Sheriff, and several of the jury. Neither the prisoners on trial nor any of those in gaol were affected by fever."—*Dr. Murchison.*

From this account it appears that the poison produced in those prisoners by overcrowding was exhaled by them, and affected those in their vicinity without any other apparent cause.

The following is a good example of the conditions under which typhus fever is produced, mentioned in Dr. Murchison's splendid work on fevers :—

"A court, 11 feet wide, with all matters as to drainage and water supply in good order, and recently constructed. Fever arose in house No. 10, which consisted of 2 floors connected by a narrow staircase.

	Cubic Feet.	
Ground floors:		
Front room, .	595	Occupied by a mother and 6 children and grandmother, who came to nurse those who were sick.
Back do., .	544	
Upper floors:		
Front room, .	680	
Back do., .	497	

"Before the arrival of the grandmother each had 163 cubic feet, after her arrival 142 cubic feet. Windows had all been shut up for the winter, and there was no means of ventilation. The rooms had the well-known animal odour of overcrowded houses."

This is only one sample of the conditions under which typhus is produced (street 36 A). I could mention a number of others from various authors, as also from the reports from the Dublin Sanitary Association and from my own experience. So many instances of this kind being recorded, and so many having been found to be the first beginnings of typhus epidemics, the conclusion is almost irresistible that overcrowding is sufficient to generate typhus *de novo.* An additional, though not absolute, proof that typhus fever is caused by overcrowding is that at the time of year at which overcrowding is greatest, namely, in the winter months, typhus fever prevails to the greatest extent, as already pointed out by Dr. Moore, although, as I have shown elsewhere, during its prevalence it is temporarily increased by increased moisture and temperature.

Enteric Fever.

The evidence that enteric fever is the direct product of food, drink, or air contaminated by the presence of decomposing sewage matter, or by the miasma exhaled thereby, is, if possible, stronger than the evidence of the production of typhus by overcrowding; because in the latter cases many other of the causes favouring the spread of Zymotic diseases

co-exist, but in many cases, with regard to the former, nearly all other causes except the presence of the decomposing matter can be excluded. I need scarcely refer, in this assembly, to the sickness of the illustrious Vice-Patron of this Society, His Royal Highness the Prince of Wales, and his hospitable and noble friends, who were struck down with enteric fever at a time when almost, if not quite every cause was excluded except sewage exhalations.

I had recently experience of an epidemic of enteric fever breaking out in a large educational establishment in this city, owing to the want of proper drainage, which led to the contamination of the atmosphere with sewage exhalations and consequent sickness of a large number of those exposed to its influence.

The class-rooms in which the various students attended lectures were situated in one building. In this same building some of the male students resided. The remainder of the male students resided in a separate house in another street. The female students resided in a third building at a considerable distance from the building containing the lecture-rooms.

In the area of the building containing the lecture-rooms were situated latrines for the use of the male students only; there was also a pump in this area, but at some distance from the latrines, from which drinking water was occasionally obtained. This pump was partly supplied by well and partly by Vartry water, but there was no evidence that this pump supplied the usual drinking water for the male pupils. The situation of the latrines was so low (but slightly above high water mark) that the drainage of these was driven back at each rise of the tide, and when the tide rose very high the area itself was flooded with sewage matter of the most disgusting character. Thus all the gases from the decomposing sewage were mixed with the atmosphere breathed by the unfortunate pupils each time they visited the area. The result was that many of those who frequently visited this area (14 out of about 70), were attacked with fever, and of these 4 died. None of the female students and none of the others who frequented the lecture-rooms and who did not visit the latrines, were affected with fever.

As instances of localized outbreaks of fever depending upon sewage contamination of water, I may mention the instances of Terling, Guildford, and Winterton, mentioned in the reports of the Medical Officer of Privy Council.

Terling is a village in Essex, with a population of about 900 souls, is very much isolated and cut off from communication

with neighbouring localities, so much so that most of the inhabitants are related to one another by marriage; their physical and moral characters are both very low. The inhabitants are nearly all farm labourers, living in houses constructed, with few exceptions, of lath-and-plaster, or worm-eaten wood. The people are all badly fed. The cottages are surrounded with almost every conceivable nuisance. "Slops and ashes," says Dr. Thorne, the Inspector who writes the Report, "thrown down in unpaved yards and gardens, manure heaps, cesspools, and masses of decaying vegetable matter"—all rubbish and excreta—lay scattered about in all directions.

"Surrounding one cottage and within a radius of 20 feet, I found one pig-stye, three manure heaps, two cesspools, and a privy the contents of which extended for 12 feet down an adjoining field."

In the centre part of the village, as shown in the map accompanying the Report, each cottage or each group of cottages has its own well, and if the ground is at all undulating this is sure to be situated at the lowest point. All are sunk in the gravelly stratum (which underlies the village) and as a rule uncovered, lined with loose bricks (without mortar or cement), depth 5 to 40 feet, according to height of ground. On a higher level and surrounding these wells, are all the nuisances mentioned above, the drainage from which, owing to the porous nature and lie of the ground, as a matter of necessity finds its way into the wells. None of the outlying houses have wells, but derive their water supply from pools in the fields frequented by cattle and described as "nothing better than stinking pools." Overcrowding was frequent, the sick sometimes being two or three in a bed; in some places 82 cubic feet of space was allowed to each person.

In this village 208 cases of fever of a very bad type occurred besides diarrhœa, and 10 cases of fever in Terling-place, the neighbouring residence of Lord Rayleigh.

The first case of enteric fever arose in the person of Lord Rayleigh' s dairy-maid, who drank the water taken from the river Lea in the immediate vicinity of the entrance of a sewer. This dairy-maid had been in Somersetshire but had returned three weeks before she got sick, and as the cases that followed next had no connexion with this case, the supposition of the introduction of the fever by this person is unlikely; it is more than probable she had also opportunities of using water from some of the village wells.

The epidemic followed the rising of the wells after their having been lowered by long-continued dry weather, the rising of the water being caused by wet weather, which,

while it filled the wells with rainwater, also washed all the dirt in the vicinity into them.

The first cases which arose after that of the dairy-maid, were in five cottages built of wood, surrounded by pigsties and dirt, all dirt being thrown out into an unpaved yard sodden with dirt, in which yard is situated the well for all the inhabitants of the row.

At No.	1	there was	1	case and	0	death.
"	2	"	1	"	1	"
"	3	"	2	"	1	"
"	4	"	3	"	0	"
"	5	"	2	"	0	"

The well had dried up and not been used for two months, and water was obtained from a well in the neighbourhood where no great diminution of the water had taken place.

On November 19, a woman was ill, not of the fever, in one of these five houses, and water was wanted for cleansing purposes but none was in the well. On November 26, water was found to be in the well and was immediately used for drinking purposes. Ten days after using this water, or at the end of the time usually allowed for the incubative stage of enteric fever, the first case of fever arose in the person who had used the water, the other cases in these five houses immediately followed the first case.

The inhabitants of another set of houses in the immediate vicinity, who were deprived of their own water supply by the drought, got water from the same well as the first set of houses derived their supply from before the 26th of November. So long as they were thus supplied no fever appeared, but 14 days after the water returned to their own well, fever appeared amongst them in due course of time. The epidemic spread in the same way to the rest of the village, and Lord Rayleigh's house became infected in a similar manner, those being affected only who used water from a well contaminated by sewage matter by leakage from a tank in the neighbourhood of the pump. From the peculiar construction of the house the portion of the inhabitants supplied with water from this source were completely isolated from those in the rest of the house.

Of course all the water in this village must have been contaminated with sewage matter for years. Why then did fever not arise before? The answer is simple; the wells were never before emptied by drought and quickly filled by wet weather, all the dirt being thereby concentrated in the first washing of the sewage-sodden earth.

An almost similar, though not so fatal, an epidemic arose at the village of Winterton. I may give an example of the commencement of this epidemic without further following its details.

A row of four houses were supplied with water from a pump well, within 14 feet of which were situated one open drain, one open ashpit, two pigsties, three privies, and one cesspool, all from 18 inches to 3 feet on a higher level than the well.

In No. 1 there lived	3 persons,	2 of whom had fever.				
2	,,	4	,,	4 ,,	,,	and 1 died.
3	,,	7	,,	7 ,,	,,	
4	,,	4	,,	0 ,,	,,	

The people in No. 4 would not drink the water because it had a bad taste, and therefore escaped the fever.

Guildford affords another example of how much influence dirty water has in producing enteric fever. This is a town which, in the year 1861 had a population of 9,000 inhabitants living in 1,675 houses. The town stands on chalk on the side of a hill. The stratum of chalk afforded a natural drainage for the town, all sewage being conducted into cesspools, which drained themselves into the chalk, and therefore remained nearly always dry, and were never known to be offensive. There was no system of drainage at Guildford at time of outbreak. The water supply was derived from several sources—

1st. From an old well sunk in chalk at the bottom of the hill, from which water is pumped by a water-mill.

2nd. A new well from which water was pumped to the upper parts of the town by engine power.

3rd. From private wells attached to the houses.

Nine hundred and twenty-eight houses are supplied from the first two sources, 747 from the private wells.

Some enteric fever always is present in Guildford in its poorer parts.

The outbreak occurred in the last days of August in the upper part of the town where it had not previously prevailed, and where the wealthier part of the population reside. What were the influences to which the infected districts became exposed, which were followed by the fever? There were in all 264 cases of fever, of these 177 were in the 330 houses supplied by the high service water supply, 30 in 598 houses on the low service water supply, and 57 in 747 which received no water from the public water works. This shows at once that those receiving the high level supply were more liable

to enteric fever than any others; and excluding the ordinary cases, and the case of children who attended school in the infected districts, but who resided elsewhere, nearly all the fever arose among those drinking the high service water which was drawn from a reservoir in the high part of the town, kept filled from the well by the pumping engine on the low ground.

Up to August 1st these people had a constant supply of water from the high level reservoir; on that day the engine broke down, and the water supply from the old well and wheel was resumed. At this time there was still some water left in the high level reservoir, which was left there exposed to the influences of the heat of August weather, which would promote decomposition of any organic matter it might contain. On the 17th of August the water-wheel broke down, and thus the second supply to the occupiers of the high level district failed. Half a loaf being better than no bread, the small residue of dirty water was supplied to those houses, and then followed the fever. The well from which the water had been pumped was found to be contaminated with sewage, which was comparatively harmless until concentrated and acted upon by exposure to the summer heat while it lay undisturbed for nearly three weeks in the reservoir.

Two points are here illustrated:—1st, how sewage contamination poisons water; and 2nd, how this poison is increased in intensity by decomposition and concentration.

An outbreak of enteric fever at Islington has been shown by Dr. Ballard to have depended upon the sewage contamination of milk from a dairy-yard pump, which had been used to increase the value of the milk to the dairyman, at the expense of the health and lives of his customers.

Of 2,000 families resident within a quarter mile radius of the dairy-yard, 142 were supplied with milk from this dairy, of these 70 were invaded by enteric fever within 10 weeks.

"It is remarkable," says Dr. Ballard, "how typhoid picked out the customers of this dairy; thus in one long road and a street issuing from it, at a distance of a mile or more from the dairy, it supplied 3 families—of these, two had typhoid. It supplied 4 families in a neighbourhood of about 70 houses—of these, 3 had typhoid; it supplied 4 families in a row of 9 houses, typhoid occurred in 2 of them; and in the other 2, cases of a mild febrile character occurred."

And so on in many other instances. Dr. Ballard also shows that only those who consumed the milk were affected by fever, and of those who worked in the dairy-yard

and did not use either the dirty milk or dirty water none had the fever. On examination, Dr. Ballard found that the pump from which the milk was, I believe, undoubtedly watered, was contaminated by sewage infiltration into the tank from which the pump water was derived.

Within the last few weeks similar examples have been presented by Dr. Russell, who showed that of 72 families in 5 streets supplied by a dairyman in whose family enteric fever prevailed, 22 had fever; and in 32 families supplied by this dairyman there arose 36 cases of fever.

In conclusion Dr. Russell remarks:

"I regard this as an extreme illustration of what most frequently happens where the sale of articles of food is conducted in close connexion with families, and all their attendant ailments. Milk is, from its composition, a peculiarly favourable medium for the propagation of the germs of disease, and particularly of enteric fever, and it is very likely that many apparently inexplicable outbreaks of enteric fever in families are caused by milk, or even solid food contaminated in the retail shops, especially among the poor. It is a very common practice in all parts of the city for parties to live and rear families in rooms behind shops, through which often the sole access lies, and in which groceries, milk, provisions of all kinds, sweetmeats, fruit, &c., are sold. These shops are 'served' by one or both parents, or by some grown-up child, and when infectious disease enters such a family, it cannot fail to be the source of quite peculiar risk to the public. I have been so much impressed with this by a series of cases in point, that I applied to Mr. Lang, the Procurator Fiscal, to ascertain what legal powers existed to deal with them. Mr. Lang writes his opinion that persons situated as described in the various instances given in your letter have not proper lodging or accommodation. It will, therefore, be possible by this and other provisions of the Public Health Act to deal with such cases, so as to save the poorer classes from the obvious dangers of contagious sickness in such circumstances. I have, therefore, issued to the Sanitary Inspectors an instruction that systematic attention be paid to the health of all families living in the circumstances described, by a more routine visitation than from the character of the people and the locality might be thought necessary. Any case of infectious disease discovered must be specially and immediately reported to the medical officer. The greatest care is to be taken not to injure the interests of the parties referred to by unnecessary publicity in the discharge of this duty; but at the same time there is a very obvious danger to the public from their private sickness, arising from their mode of living, which quite warrants the interference of the department.'

"The fatal activity of milk as a cause of disease has also been most carefully and scientifically investigated by Dr. Taylor, of Penrith; Dr. Bell, and Dr. Thorne. It has been shown that not only

typhoid but small-pox, scarlatina, and even cholera, have probably been communicated to people through the medium of milk. It is, therefore, of the utmost public importance to inquire into the sanitary condition of the cow-sheds and dairy-yards.

"The following is a graphic description of the dairy-yards in the south side of the city, by Mr. Benson Baker, of London, who published some notes on a sanitary tour through Dublin about two years ago. Any one who will take the trouble to investigate the matter now will find it equally applicable :—'In the most densely-populated and fever-infected district, in close vicinity to the Corporation manure depot in Marrowbone-lane, are to be found the cow-sheds and dairy-yards of Dublin. These yards, like the neighbourhood, are abominably filthy; manure is allowed to accumulate in heaps, from which may be seen small black fetid streams flowing into the open streets. The effluvium from these yards is absolutely poisonous, and is only equalled by the atmosphere in the cow-sheds. In this district man and beast alike fall easy victims to preventable disease.' Speaking of the condition of the cows, he adds—'Dr. Cameron says that the loss from pleuro-pneumonia sustained by Dublin dairymen is at least 10 per cent., yet the dairymen cannot be convinced that the disease is contagious, and, therefore, unless under compulsion from the sanitary authorities, they never disinfect their premises after the removal of diseased beasts from them.' The vital powers of the cows are lowered by their constant respiration in close fetid stables. In some of the sheds the cubic space allowed for a large cow is less than the minimum—viz., 300 cubic feet of breathing room—allowed a man in a registered lodging-house. The cows were so close to each other that it was impossible that they could all lie down together. On questioning the owner on this point he facetiously replied, 'Gorrah, sir, they take it turn about.' This repartee might excite a laugh if the occasion of it did not inflict cruelty on the beasts, and tend to affect the people with disease. It is not surprising to learn that milk obtained from cows herded together in such unsanitary conditions, not only conveys foot and mouth disease, but typhoid and other zymotic diseases to the consumer."

I have little doubt that many cases of fever and diarrhœa are produced in a similar way in Dublin, by the sewage contamination of milk. Any one who visits a Dublin dairy-yard, must have been convinced that the milk derived therefrom must run great chances of sewage contamination of some sort, for more fearfully filthy places can scarcely be imagined. Where causes of enteric fever and typhus co-exist, both diseases will arise at same time and sometimes even in same person, as I have shown to be the case in an account of fever at 50 Bishop-street.—*Irish Hospital Gazette.*

While on this subject I may mention that not only enteric fever, but cholera, small-pox, and scarlatina, are liable to

spread in this way. I have treated dairy-maids for small-pox and scarlatina; and I regret to find on Dr. Mapother's street list of cholera in Dublin, in 1866, which he has kindly lent me for the purpose of this lecture, that many dairies are included as having been invaded by this disease. Dr. Taylor has demonstrated how scarlatina was spread in Penrith by means of milk, and similar observations have been made by Drs. Bell and Thorne. I believe I narrowly escaped a visitation of cholera in my own house from a similar cause in 1866. It is to be hoped that if, notwithstanding Dr. Cameron's efforts, our dairymen still persist in diluting our milk they will confine themselves to Vartry water. Dr. Reynolds has shown you how to distinguish in many ways good milk from bad, but unfortunately no means is as yet known for distinguishing milk poisoned by disease germs. The same conditions which favour the spread of enteric fever, also favour the spread of diarrhœa, and in point of fact many deaths of enteric fever, especially in children, are registered as cases of diarrhœa. Enteric fever is a disease of summer, when the decomposition of sewage matter is favoured by the high temperature. Additional proof of the constant influence of poisoning by sewage matter is drawn from the Reports of the Medical Officer of the Local Government Board (formerly of the Privy Council) of England, where in every instance where a town is reported as infected by enteric fever, we find that the arrangements were such that the inhabitants were poisoned by their own sewage.

Relapsing fever is generally believed to be the direct product of famine, but being contagious may communicate itself to well-fed persons. It is as Dr. Stokes informed you, when speaking of the great famine fever, frequently followed by typhus.

Cholera.

In close relation to enteric fever as to causation, stands cholera. The most constant condition connected with the spread of cholera is an impure water supply, or a supply contaminated with sewage matter. I could give numerous instances of this, but shall confine myself to the one of London, where terrible experiments have been carried out on a most gigantic scale, which prove the relation between impure water supply and cholera. I do not mean to say, positively, dirty water produces cholera, but it certainly promotes it, whether by containing the germs of that dire disease, or by merely affording a suitable and apparently necessary soil for the disease to grow upon.

This I may say has been demonstrated by the various effects produced in London by the different cholera epidemics of 1854, 1849, and 1866, on each district according to the nature of the drinking water supplied to the inhabitants. This was first pointed out by Mr. Simon, in his "Report on the cholera epidemics of London, as affected by the consumption of impure water," published in 1856. This Report was the result of most painstaking and lengthy inquiry into the most minute details of water supply, population, and distribution of cholera in 1849 and 1854, in the London districts lying south of the Thames. A similar report by Mr. Radcliffe has been published in the Report of the Medical Officer of Privy Council for 1866, showing the connexion between the diffusion of cholera and impure water supply in the east end of London, in the last cholera epidemic, that of 1866.

In the epidemics of 1849 and 1854, cholera fell with the greatest severity on the portion of London lying south of the river, under the following circumstances:—

There were, and I believe are still, two companies supplying this district (which comprises St. Saviour's, St. Olave's, and St. George's, Southwark, Bermondsy, Newington, Lambeth, Wandsworth, Camberwell, and Rotherhithe) with water, the competition was great between these two companies, so great that out of 31 sub-districts there were but eight which had but one company's mains within it, and in many cases the mains of both companies run parallel in the same streets, supplying about equal number of the houses. Thus the population supplied by the two companies were so intimately mixed, that with the exception of the water supply the conditions were identical. We have thus a most perfect arrangement for testing the influence of bad water in promoting cholera. The two companies in question were the Lambeth Company and the Southwark and Vauxhall Company, supplying a population of about 466,000 in 1849, and about 511,000 in 1854.

In 1853 and '54, the Lambeth Company, which derived its supply from the Thames at Ditton, a source pure (dirty though it may be) in comparison with that of the sister company, supplied 24,854 houses, comprising a population of 166,906 persons, and there occurred 611 cholera deaths, being at the rate of 37 to 10,000 persons living.

The Southwark and Vauxhall Company derived their supply from the Thames at Battersea, which was "found to be of almost incredible foulness," swarming with living things and filled with particles of dirt. In 39,726 houses, comprising 268,171 persons, there occurred 3,476 cholera deaths, or

at the rate of 130 to every 10,000 of those living, or about three and a half times as many as those drinking the better water.

In 1854 the Lambeth Company gave the best water, but in 1849 it gave worse than the Vauxhall Company, for the Lambeth Company during the interval moved their works up the river, while the Vauxhall Company remained where they were, and even this source became more impure from the increased drainage poured into the Thames by the increased population of London. Accordingly we find that in the epidemic of 1849, in the houses of the Lambeth Water Company's tenantry, there died no less than 1,925 persons, although the population was less than in 1854 when but 611 died of cholera.

In 1849 there died among the Vauxhall Company's tenantry 2,880, or less than the 3,476 of 1854; making all allowances for increased population, the mortality was higher than 1849, and the water worse. It is thus clear that, in the southern districts of London where the water supply improved, cholera was less, and where it became worse cholera was more prevalent. In 1866, when, by the enforcement of a new Act of Parliament, the Vauxhall Company had been compelled to obtain a new supply, and the Lambeth Company had improved its supply, there was but little cholera on the south side of the Thames. On the other hand, a dirty water supply poisoned the greater portion of the east end of London on the north side of the Thames, as shown in Mr. Radcliffe's report, previously referred to.

The East London Water Company supplied two districts, both of these were infected by cholera, one severely, the other but slightly. There were two sets of reservoirs—one at a place called Lea Bridge, the other Old Ford. The district supplied from Lea Bridge was severely affected; that supplied from Old Ford was terribly swept by the epidemic. But why was this when the water was from the same sources in both cases, and why did not cholera always pervade the population supplied from the Old Ford reservoir? The "Old Ford" reservoir was contaminated by sewage from the River Lea, which at that point was a sort of canal, into which drains emptied themselves, and which were possibly even contaminated by the drainage from the first cholera cases. It was not until in consequence of a short supply of water that this reservoir was used that cholera spread through the district. A map accompanying the report shows, by shadings, the various degrees in which cholera invaded the different districts of London in 1866, and graphically demonstrates how

fatally the district supplied by the Old Ford reservoirs of the East London Water Company were affected.

The story of the Broad-street Pump by Dr. Snow further proves the influence of dirty water in spreading cholera, as also did a special outbreak in connexion with a pump in Duke-street, in this city. Thanks to the exertions of my friend and fellow-citizen, Sir John Gray, we are not likely ever to suffer from the effects of an impure water supply; and I have no doubt that when cholera again visits us we shall have few such stories as that of the "Duke-street Pump." But we must not here forget Dr. Reynolds' remarks about the poisoning of water by dirty cisterns.

Valuable evidence in support of the connexion between cholera and water supply is given in Dr. Pettenkofer's papers on the connexion between cholera and ground water; as also the instructing paper by Dr. Mapother on the relation between old rivers and sewers, and the distribution of cholera in Dublin, in which he showed the predilection of cholera for these sites.

Measles.

Next, we have to see under what circumstances measles arise. The only conditions yet shown to be intimately connected with measles are decomposition of vegetable matter, especially straw, and the presence of the lowest forms of fungi, commonly called mustiness.

Dr. Salisbury, of Newark, Ohio, United States, has demonstrated, beyond doubt, his ability to produce measles (or a disease undistinguishable from it), just as the gardener can produce mushrooms by preparing a bed upon which they are to grow.

Dr. Salisbury refers to the various fungi which attack grain as smut and bunt, to those attacking animals as Mursadine (*Botrytis Bassiana*) attacking the silkworm, and the mould which kills the house fly in autumn (*Sporendonema muscæ*), and which we see as white rings around the poor little animal's body, and finally against our window panes after the death of the fly. Many skin diseases are now known to be associated with the production of vegetable growths on the surface of our bodies.

1st. Dr. Salisbury points to the case of Mr. Dill, who got an attack undistinguishable from measles while engaged in turning over a stack of musty straw, the odour from which persistently remained in his nostrils for long after he had done handling the straw.

2nd. In an outbreak of measles at the military camp

near Newark, Ohio, there was no trace of contagion; the outbreak followed immediately on the melting of the snow while wet, which made musty the warm straw which the men slept upon in their tents.

3rd. Cases mentioned by Mr. S——, in the persons of those employed in thrashing wheat that had become heated.

These cases suggested to Dr. Salisbury the inquiry, whether camp measles were caused by musty straw. He examined the musty straw (wheat straw) to which had been attributed the cause of the measles, he found certain fungi which are figured in his work. He, to prove their identity with wheat straw fungi, grew them in a box.

He then grew some fungi with which he inoculated himself, and produced the symptoms of measles with a partially developed rash; a second inoculation failed to produce similar effects. Similar effects were produced by inoculation of his wife.

In a family where measles broke out, inoculation by the straw fungi, while giving measles of a modified form, prevented the occurrence of unmodified measles. These are substantiated by other evidence, and are still further proved by the observations of Dr. Moore, which proved that measles is a disease of warm weather, or in other words, of that kind of weather which promotes the growth of the lowest forms of fungi and mouldiness.

Measles have been also shown to arise in connexion with musty linseed meal, by my friend and former colleague at Cork-street Hospital, Dr. Henry Kennedy, in a paper in the Dublin Medical Journal.

The only miasm which has as yet been shown to have any special connexion with scarlatina is that arising from the decomposition of slaughter-house refuse. This origin for scarlatina was first suggested by Dr. Carpenter of Croydon. Scarlatina has also been attributed to overcrowding; but I have not yet been able to convince myself that the prevalence of scarlatina in connexion with overcrowding is to be attributed to any other effect of overcrowding than the well known tendency of that condition to favour the spread of contagion. To consider the question of the influence of slaughter-house refuse—Dr. Carpenter has shown in 9 cases of localised epidemics of scarlatina where the possibility of contagion seemed to be excluded, that the presence of decomposing slaughter-house refuse was the only assignable cause. It is unnecessary to give the details of these cases, but the most of them occurred under circumstances where all other sanitary arrangements were good.

The origin of scarlatina in connexion with decomposing

slaughter-house refuse, is further confirmed by an analysis of the death registry of No. 2 district of the south city district, undertaken by Dr. Maunsell, who found that out of 6,000 deaths registered in that district during the nine years 1864 to '72 inclusive, there were 268 deaths from scarlatina, of these 95, or more than one-third, occurred in the immediate neighbourhood of the slaughter-houses connected with the Clarendon, Castle, and Blackhall Markets, and another limited neighbourhood containing but one slaughter-house. The area in which these deaths took place is but one-eighth of the whole district. Two of these slaughtering districts are not remarkable for the prevalence of Zymotic disease.

The conditions which are essential to the production of whooping-cough are at present unknown, but the constancy with which it follows measles, points to the fact that what will control the latter will also control the former. Dr. Moore has shown how whooping-cough prevails in winter, measles in summer—the former following the latter and being aggravated by the effects of low temperature, favouring chest affections generally. No condition is yet known essential to the production of small-pox, but this is the most preventable of all Zymotic diseases by the simple and certain method of vaccination, so certain and safe a measure, that everyone is convinced of its certainty and safety except a few misguided and wrong-headed people who are more to be pitied than feared, and who should for the safety of society be handed over to the Commissioners who take care of the welfare of persons of weak intellect.

If other instances were required to show the value of sanitary measures, they could easily be produced. I will only mention two others as being derived from our own city. The cases of *trismus nascentium*, or nine days' fits, arising in infants in the Lying-in Hospital which have been I might say, annihilated by the preventive measures of ventilation and cleanliness first instituted by Dr. Clarke, and thus described in Dr. Churchill's able work on diseases of children:—

"No institution as far as I know has ever afforded such ample experience of the disease as the Dublin Lying-in Hospital, before the improvements in ventilation and cleanliness introduced by the late Dr. Joseph Clarke, to whom we are indebted for the best description of the attack. Dr. Joseph Clarke enumerates three especial existing courses of the disease—first, impure air; second, neglect of keeping the infants clean and dry; and third, irregularity of living on the part of the mothers, especially the abuse of spirituous liquors. At the end of the year 1782, of 17,650 infants born in the Rotunda Hospital 2,944 died within the first

fortnight, or nearly every sixth child, and that owing to trismus. After the precaution he (Dr. Clarke) adopted the same pure and adequate ventilation in the hospital, out of 8,033 born alive, only 419 died in the hospital, or only 1 in 19½. During Dr. Collins' Mastership, of 16,654 infants born there were only 37 cases of trismus. Here is a splendid instance of the results of preventive medicine."

The other is the case of puerperal fever, a disease originating in the overcrowding of parturient women, as referred to in Dr. Farre's letter, quoted in the commencement of this lecture, which I think is very well shown in Dr. Evory Kennedy's work on this subject and the truth of which I believe has been fatally demonstrated in the Dublin Lying-in Hospital, but which, thanks to the reforms introduced by the late Dr. Collins, to the energetic efforts of the present Master, Dr. Johnston, and to the knowledge of defects pointed out by Dr. Evory Kennedy, is not likely again to afford the opportunity for demonstrating the dependence of this disease on bad sanitary arrangements.

Puerperal fever can, I believe, be almost if not altogether annihilated, like the nine days' fits, by isolation of the mothers either by separate buildings, as suggested by Dr. Kennedy, or by the complete isolation of the various wards by some other means.

Having shown the chief, original, and promoting causes of zymotic disease, it is manifest that the remedies are—

1. In building new towns or villages to select healthy sites.

2. Proper drainage, both house drainage and general drainage.

3. To prevent old ruinous and dirty houses from being inhabited, and to prevent new houses from being constructed so as to be injurious to the health of their inhabitants. Mr. Henderson will point out in his lecture how this is to be effected.

4. To prevent overcrowding either in houses or districts. This must be accomplished by constant inspection of all houses inhabited by the poor, by the regulation of the width of streets, the promotion of open spaces within towns, and by the breaking up of closed courts, and the making of wide thoroughfares through closed up neighbourhoods.

6. To promote cleanliness—1st, By the employment of all legal powers to compel and assist in the removal of dirt; and 2nd, To educate the people to believe that "cleanliness is next to godliness."

7. To provide proper accommodation for the sick at all times, and also during epidemics:—(*a.*) By proper hospital

accommodation at all times. (*b.*) By proper means of bringing patients to hospital. (*c.*) By the provision of special hospitals or wards, in connexion with general hospitals, to be used only in time of epidemics. (*d.*) Refuges where the healthy can be separated from the sick until the sick can be removed to hospital, and the houses or rooms they occupied cleansed and disinfected. (*e.*) The provision of accommodation for convalescents from zymotic diseases in convalescent homes. (*f.*) Proper and systematic disinfection of all places where sickness prevails or has prevailed.

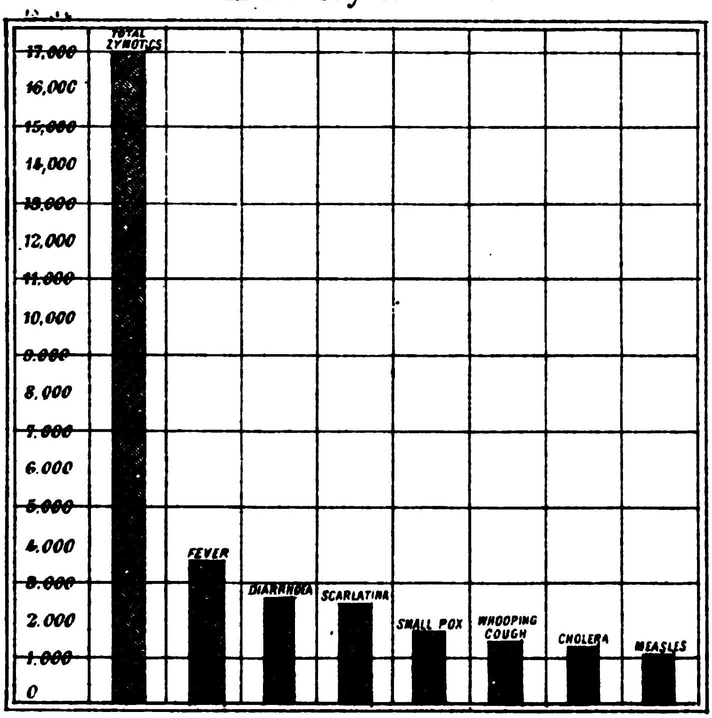
These must be all accomplished by means of a well organised sanitary system, and I am sorry to say such a system exists in but few large towns, not at all, I may say, in the country, and scarcely anything worthy of the name of organization is at present to be found in Dublin. The treatment of the sick and the prevention of disease should be under the same department, which should also have under its control all matters for the relief of the poor, registration of births and deaths, and the performance of vaccination. Each large district should be under a Chief Medical Health Officer and every dispensary district should have for its Sanitary Officer the dispensary Medical Officer acting under the Chief Officer of the district. The Chief Officer should have almost absolute power, and should be only appointed with the consent of, and also removed by the chief sanitary authority of the state, namely, the Local Government Board. The absurdity of placing the administration of sanitary matters under the *absolute* control of Committees of Town Councils and Poor Law Guardians, many of them frequent offenders against sanitary law, is so great, that it will be at once perceived by every intelligent and thoughtful person.

I wish now to return my thanks to those who have given me their assistance in collecting materials for this lecture, namely, to Mr. Simon, the Medical Officer of the Privy Council; Dr. Burke, Medical Superintendent of the Irish General Registration Office; Dr. Ballard, of the English Local Government Board; Dr. Mapother, Medical Officer of Health for this city, and Dr. Maunsell, the able and energetic Secretary of the Poor Law Medical Officers Association. I have endeavoured to fulfil my difficult task to the best of my ability, and I trust that any shortcomings may be excused, and that you will believe that I have done my best to make a grave medical subject as little unpleasant and as interesting and useful as possible.

DIAGRAM IV.

Showing the Comparative Mortality from the seven principal Zymotic diseases during 9 years, from 1864 to 1872 inclusive.

in the City of Dublin.



VI.—*On Liability to Disease.* A Lecture delivered by ALFRED HUDSON, M.D., Dubl., M.R.I.A., President of the King and Queen's College of Physicians in Ireland.

In his lectures on Public Health Dr. Guy observes that the science of Hygiene "makes application of a knowledge remarkable for its amount, and the great variety of sources whence it is derived."

The truth of this observation has been illustrated by the gentlemen who have preceded me with reference to the sciences of chemistry, meteorology, and geography, and to the social condition and vital statistics of the community, and the relation of each to the genesis and diffusion of epidemics of zymotic disease. It now devolves upon me to occupy your attention for a short time with the consideration of those internal conditions and external agencies which increase our liability to disease, or, to use the language of the profession, act as predisponents or predisposing causes: and inasmuch as these conditions are either inherent in our constitutions, or involved in those surrounding agencies which minister to the nutrition of our bodies, or that molecular change, progressive and retrogressive, essential to healthy organic life, it will not be possible to explain their mode of action without reference to the laws which regulate this important function.

In the spread of epidemics two factors have long been recognised and illustrated by different comparisons. One of the best, says Dr. Hecker (in his History of the Epidemics of the Middle Ages), is the German word signifying "setting on fire" which compares the exciting disease in the *appropriate body* with the inflammation of combustible matter by the application of fire, or with the kindling of gunpowder by a spark. Another analogy employed by several writers compares the *materies morbi* to seed; the human body to the soil into which it is received, and concurring agencies to the seasonal influences which favour its germination, growth, and ripening, or reproduction.

This analogy corresponds to the three agencies which we severally denominate exciting, predisposing, and determining causes; by the first of which we denote the zymotic poison; by the second all those influences, intrinsic or extrinsic, which augment liability to disease; and by the determining cause anything which suddenly diminishes vital resistance to disease and neutralizes that conservative power by which noxious agents are assimilated and cast off from the blood; and thus determines the time and circumstances, but not the nature, of the invasion.

It has been held that "whenever predisposition and the specific poison are concurrently present the disease is invariably produced." We cannot admit the absolute truth of this dictum unless we deny the existence of that power which physiologists ascribe to the blood of assimilating and rendering innocuous, and eliminating noxious agents received into it from without; and we have moreover opportunities of recognising the influence of causes which while they suddenly depress the vital powers at the same time render active the germs of disease previously latent in the body. An example of no rare occurrence will illustrate this. An individual has been exposed to the contagion of typhus from day to day, but has hitherto assimilated and eliminated the poison received into his blood. He is brought into the immediate presence of a small-pox patient, and experiences a powerful feeling of fear or disgust, and forthwith sickens not with small-pox but with typhus. Here we have the seed and soil, in other words, the specific poison and liability, co-existing without disease being set up until a third influence intervenes, which we therefore denominate the determining cause. By thus recognising three factors we are enabled to explain not only such cases as that just mentioned, but also the immunity to contagion apparently possessed by individuals under long continued exposure, and those examples of sudden invasion under some special exposure recorded by Sir H. Marsh, Dr. Law, and other writers on fever.

It is no part of our present purpose to inquire into the sources or mode of action of contagion or to argue that it is a true ferment which being received into the blood excites in substances similar to those in which it originated changes identical with those which produced it, like thus following like, production and reproduction going on in a continuous series; or that it is a living germ having the power of multiplying itself in the blood of the infected person, or as has been recently argued "that a contagium particle is a

detached portion of a diseased living body which coming in contact with a previously healthy body modifies the entire organism."*

It is not necessary for our present purpose to accept any of these explanations, and therefore in using the terms applied to any theory of contagion I wish not to be understood as adopting that particular theory.

There are however two facts in reference to the action of contagious zymotic poisons, it may be well to notice as bearing on our subject.

The first is that the liability to the special poison is exhausted in a greater or less degree by an attack, the liability to others being unaffected. This is particularly observable in regard to typhus and other eruptive fevers (exanthemata).

This fact, which has been somewhat differently explained by different physiologists, accounts for the much greater prevalence of epidemic diseases when introduced into virgin populations or those among which no previous epidemic of the kind had ever existed.

We have examples of such general liability in the histories of epidemics in populations unprotected by previous attacks, and under influences favourable to the spread of contagion. Such was the epidemic of measles which ravaged the Faroe Islands in the year 1846. It appears that the disease had not visited the islands for more than half a century; and that the ordinary rate of mortality of the islanders is very low; but it is stated by Dr. Parnum who investigated the epedimic in question, that it attacked scarcely less than 6,000 out of a population numbering between 7,000 and 8,000; few escaping except such as had suffered from the former epidemic or those who maintained a very rigorous isolation.†

Similar examples are found in the epidemics of small-pox in unprotected communities, more especially when introduced into America after the discovery of that country; three millions and a half of human beings having perished in Mexico alone. It has been stated that on its introduction into Canada 22,000 of the Red Indians were carried off by this disease, and that in Iceland in the year 1707 it destroyed 18,000 or more than one-third of the entire population.

Similar examples are recorded in the histories of the Black Death and sweating sickness of the middle ages. Of the former there died in London alone at least 100,000,

* Ross—"Graft Theory of Disease," chap. 2.
† *British and Foreign Medico Chirurgical Review*, vol. 7.

according to Hecker, and this writer estimates the mortality in Europe at 25,000,000.

The accounts given by historians of the habits of living and surroundings of most of the populations thus scourged, are such as fully explain their exceptional liability, and find their counterpart in the condition of the Mohammedan pilgrims during the last epidemic of cholera you lately heard so graphically sketched by Dr. Little, as also in that of the Irish peasantry in the famine of 1847–1848.

The other fact to which I have alluded is that each epidemic of contagious disease presents an uniform type, conformable to itself, not only in different places at the same time but also at different periods however remote, and that whenever exceptional forms and complications do occur these are due either to the co-existence of another epidemic or to special and exceptional forms of liability in the individual affected; the law being that with regard to the disease the poison has a special affinity or attraction for the organs or tissues according to its nature and the source from which it proceeded or was eliminated, as the skin and throat in scarlatina, the intestinal follicles and mucous membrane in cholera and enteric fever; and that with regard to the individual attacked those organs are found to become the seats of special complication which are specially predisposed in consequence of their undergoing increased disintegration or waste of tissue at the time of invasion of the disease.

We thus explain the increased liability to suffer cerebral and nervous complications in fever of the hard worked and anxious student or professional man, as well as many other complications not belonging to the disease *per se*, but to be ascribed to some condition in the individual affected.

Of the causes of liability or predisposition some are either inherent in our constitution, or in cosmical conditions not under our control, others being conditions in us or around us which are preventable and are therefore more peculiarly the subject of hygienic measures.

We may glance for a moment at some of the former before entering on the consideration of the others.

The first are those congenital or inherited constitutional peculiarities sometimes observed in an individual, sometimes in several members of a family, by virtue of which some persons appear to possess an absolute immunity from zymotic disease under any amount of exposure, while on the other hand, others succumb to its influence whenever exposed.

At a recent meeting of one of our Medical Societies, the case was mentioned of a lady whose liability to smallpox was such that she had suffered seven attacks of this disease. Nor is this a singular instance.

Different members of a family not unfrequently share in this kind of susceptibility, and the records of medicine moreover contain numerous examples of a family predisposition to suffer some unusual or exceptional complication in the course of typhus or other zymotic disease. Of course these inherent and inherited forms of liability cannot be prevented, neither can the family tendency to certain complications be explained, farther than by supposing that there exists in such individuals not only conformity of type of structure, but also a conformity in those "affinities existing between definite tissues and definite substances, which must be referred to peculiarities of chemical constitution in virtue of which certain parts are enabled in a greater degree than others to attract certain substances from the neighbouring blood." *

Another non-preventable form of liability is that attendant upon the evolution of organs, and the rapid metamorphoses of tissue during the growth of the body. That the liability to certain diseases both diathetic and zymotic is most remarkable during the periods of childhood and adolescence is well known. We find the explanation of the fact, so far as it can be explained, in the greater activity of the formative process and consequently great necessity that the balance of forward and retrogressive change should be preserved, and moreover that the balance of evolution of the several organs should be so adjusted that none of the materials appropriate for the maintenance of any part may remain in the blood; "since each part, by taking from the blood the materials it requires for its nutrition, prevents the accumulation and excess of such matters in the blood as effectually as if they were separated from it and cast out by the excreting organs specially provided for that purpose."†

It follows of necessity that the period of growth and development is one of general liability, capable of being augmented by various agencies, extrinsic or intrinsic, till it amounts to predisposition or proclivity to disease.

Another and remarkable example of liability, is that caused by the involution and disintegration of an organ which has fulfilled a temporary purpose in the economy, and the consequent presence of its effete materials in the blood. Such is

* Vinhow, Cellular Pathology, page 123.
† Kirke's Physiology, page 95.

the case of the puerperal female whose liability to zymotic disease is well known.

Dr. Moore has already illustrated the influence of season and of atmospheric changes as *exciting* causes of disease; they have also an influence on our organism, predisposing to different types of disease as well as to different diseases at different periods.

The researches of Dr. Edward Smith and other physiologists have shown that great variations in the vital processes occur at different periods of the year, and that an exaggeration of these constitutes a form of liability to disease, and impresses a type upon disease, varying according to the season, "the tendency generally being to sthenic and inflammatory forms of disease in spring when the amount of vital action is at a maximum, and to those of an asthenic type characterized by exhaustion in the latter end of summer and in early autumn." "It appears, however, that the rule, though generally true, is not universally so, but that the effects of season are modified by the constitutional peculiarities of individuals, and that the selection of certain individuals as the earliest victims of an epidemic of influenza or cholera is due to the comparatively greater influence which certain external conditions exercise upon the vital powers of the system in these individuals."*

There cannot be a doubt that the cycle of change of the seasons is adapted by the all-wise Creator to our bodily and mental constitution, and that any marked deviation from their order must be injurious, whether it be the unusual prolongation of a season, or its abbreviation, or the excess or defect of its characteristic phenomena. Thus, prolonged wet or drought, prolonged cold and frost, or prolonged summer heat, are each injurious. Warm and moist winters are proverbially unhealthy, as are cold, dark, and ungenial days, with deficiency of sunlight, in spring. The last especially predispose to typhus, while long, hot summers not only favour the generation of the malarial poisons, but moreover render the body predisposed to their reception and influence, more especially when passing suddenly into a cold and moist, because late, autumn.

The last non-preventable predisponent I shall notice is that mysterious atmospheric agency which medical men recognise by the terms epidemic constitution, epidemic influnece, or, in the words of Inspector-General Lawson,†

* Health and disease as influenced by the cyclical changes in the human system, chap. 6.

† Army Medical Reports, 1861, page 405.

designate "Pandemic wave," "a series of waves generated in southern latitudes which flow to the north or northwestward in succession, leading to an increase of fever at every point over which they pass." "It must be admitted," says Dr. Lawson, "that as in different countries different forms of fever prevail under the same general influence the pandemic cause determines the frequency and severity, rather than the particular form of the fever, which there are many reasons to conclude is more intimately connected with the local circumstances at the time. . . . It is characteristic of a pandemic wave that during its passage local causes which, under ordinary circumstances, seem to exercise inconsiderable influence over the health of those exposed to them, then display a potency which, if regarded without due weight being given to the reigning pandemic influence, seems quite unaccountable."

Of the existence of some such general cause or influence, and of its power to stamp its peculiar features upon prevailing zymotic disease, or to cause certain exceptional complications to occur during the period, no careful observer can entertain a doubt; but neither can we offer an explanation of the *modus operandi* of this occult and mysterious influence or suggest any measures by which it can be neutralized or prevented.

Of those predisposing causes, more important in a hygienic point of view, which are preventable by suitable precautions on the part of individuals or the community, it has been remarked by Dr. Carpenter "that they all tend to introduce an accumulation of disintegrating azotized compounds in a state of change in the circulating current," and are all reducible to three categories:—*

I. Those which tend to introduce into the system decomposing matter that has been generated in some external source.

II. Those which occasion an increased production of decomposing matter in the system itself; and,

III. Those which obstruct the elimination of the decomposing matter normally or excessively generated within the system, or abnormally introduced into it from without.

It has been observed that liability to disease in a general sense is a law of our being, involved so to speak in the function of nutrition, or that function by which is effected the continual progressive and retrogressive change of the

* *British and Foreign Medico Chirurgical Review,* vol. xi.

particles of our bodies; each organ or tissue attracting from the blood the materials adapted to its own growth or maintenance, while the products of retrograde metamorphosis—in other words the effete materials of the tissues—are resorbed into the blood, and by combination with its oxygen form new and devitalized compounds fit only to be eliminated or cast off by the various excreting organs; the carbonized products being chiefly eliminated by the lungs and liver, the azotized by the kidneys and other emunctories.

It follows that this process of continual molecular change necessarily involves the temporary presence in the blood of a variable amount of matters in a state of progress to decay, the elimination of which is essential to health.

We know that this elimination and the preservation of health depends mainly on the healthy condition of the three factors of nutrition, the blood, the tissues, and the nervous system;* the first requiring healthy digestion, healthy respiration, and healthy secretion, for the preservation of that assimilating power it possesses, by which many noxious substances introduced into it from without are changed and made harmless, and ultimately eliminated; the second being equally necessary, inasmuch as the unhealthy tissue reacts upon the blood, furnishing oftentimes a permanent supply of noxious ingredients upon which a *dyscrasia* or blood disease depends.† The necessity of a due supply of nervous influence for the nutrition of the body or of any portion is proved by numerous examples,‡ as is also the important part in predisposition played by the exhaustion of this influence by excessive and long continued exercise, whether mental or bodily, anxiety, or other depressing emotion on the one hand, and the protecting power of the opposite condition of mental and physical energy and activity upon the other.

In short, it will be found that so long as the functions of these several factors of nutrition are duly performed, and coadapted to each other, so long the equilibrium of health is preserved, and the reaction against morbific agencies is maintained; but if the health of the blood suffers by contamination from within the body or from without, to the loss of its assimilating power; or the healthy metamorphosis of the tissues is interfered with; or an important excreting organ fails to exercise its depurative functions; or by some severe shock or prolonged strain the nervous influence is per-

* *Vide* Sir James Paget's Lectures on Surgical Pathology, lectures 1 and 2.
† *Vide* Virchow's Cellular Pathology, lecture 6,
‡ *Vide* Paget, lecture 2.

verted or lost; "the continuous adjustment of internal relations to external relations" in which healthy life consists* becomes imperfect, the reaction against external morbific agencies is no longer maintained; to the receptivity of these which exists in all constitutions is added the incapacity of assimilating and changing so as to eliminate them by excretion, in which proclivity or predisposition to disease essentially consists, and the zymotic poison being introduced from without —whether in the form of contagium particles detached from living diseased bodies, or of miasm emanating from other sources—its special dynamic effects are set up in the blood, and there follows disease conformable to its source or type, with local affections due either to the elective affinities of the poison for the organs or tissues in which the contagium is generated, or to pre-existing conditions of the organs thus affected; and, finally, the reproduction and diffusion of the contagium.

This view of the essential nature of predisposition corresponds with the explanation given by Dr. Carpenter of the mode of action of predisposing causes, viz.:—

> "That all the recognised predisposing causes of zymotic disease tend to produce in the blood an undue accumulation of azotized matter already in a state of retrograde metamorphosis, and therefore precisely in the condition in which it is most readily acted on by ferments, . . . and that the liability of each individual among a number who may be concurrently exposed to the same poison will mainly depend upon the degree in which his blood may be charged with the matters in question."

Dr. Carpenter's theory not only explains the action of causes predisposing to disease generally, and to special complications in particular, but it also explains the injurious influence of the latter upon the disease, and the well known fact that the fatal termination of many cases of fever and scarlatina is due to continuous infection arising from the reception into the blood of the products of regressive change; constituting what are denominated by pathologists the secondary contaminations of febrile diseases.

Under his first category of predisposing causes Dr. Carpenter classes putrescent food, water contaminated by decomposing matter, and contaminated respired air.

Of the first no more striking example could be cited than that of the Faroe Islanders already referred to, whose extra-

* H. Spencer's Biology, vol. i.

ordinary liability to zymotic disease is to be accounted for by their diet, thus described by Dr. Parnum :—

"During the many months that the fish, flesh, or fowl is neither fresh nor yet wind dried it is called 'rast,' a word which I can only translate by half-rotten. This appellation it fully deserves from the horrible smell that it sends forth, from its mouldy aspect, and the numerous maggots which swarm upon it. I have seen a boat's crew of eight men eating with relish the raw flesh of the ca'ing whale, though it was so decomposed that the smell of it was disagreeable to me even in an open boat, and the bottom of the boat was almost white with the maggots that fell from the decaying mass."

We can scarcely wonder that on the introduction of the zymotic poison of measles nearly six-sevenths of the population were attacked, or that a most exhausting diarrhœa, often continuing for months, was a frequent sequel of the disease.*

Of the influence of contaminated water as a predisponent to cholera and enteric fever, and as powerfully augmenting the severity of these diseases, the proofs are so numerous and so well known that I need not dwell on them; besides you have already heard from Dr. Grimshaw abundant evidence of the intimate causal relation between this agent and zymotic diseases.

The same remark applies to the respiration of the gases arising from decomposing human excreta or "civic miasm," but just as there are some individuals who, because contagion does not affect *all* who are exposed to its influence, do not be-

* It should be remarked that the evil effects of the excessive use of animal food are by no means exclusively confined to that in a state of putrescence. It is, however, not so much as a predisponent to zymotic disease as the cause of serious and often fatal complications that the influence of a too highly animalized diet is observed.

The dangers of a state of rude health produced by full living have been thus graphically sketched by the late Mr. Travers:—

"The state of rude health, as that phrase is commonly understood, I consider to be a forced state, that in which the nutrical powers are tasked to the uttermost and successfully struggle with a surplus of diet and stimulus, ridding the body of both by the action at its full stretch of every excreting organ. The subjects of this class are perpetually running upon the boundary between health and disease, a sudden shock deranging some important function destroys the equilibrium of the machine which its over pressed powers are the less capable of reinstating," &c.

Except in regard of nomenclature, there seems little difference between the teachings of a great surgeon of the last half century and those of the physiologists of the present day.

I find predisposition to epidemic disease ascribed to the excessive use of animal food by Sims, in his description of a remarkable epidemic of typhus in 1771, and by Hecker in his account of the sweating sickness of 1517, which prevailed exclusively among men, "who," says Hecker, "eat spiced meat to excess, but who were also addicted to nocturnal carousings, and drank strong wine on rising in the morning."

lieve in its existence—at least as an essential element in the causation of disease—so there are others who, because individuals or families live for months and even years in the midst of filth, and habitually breathing air loaded with fœcal miasma with apparent impunity, question the influence of such miasm as a source of the poison of fever, or exciting cause of the disease.

The answer to this objection is, that immunity under such circumstances is owing to the power which the blood possesses of assimilating and rendering innocuous noxious matters received into it from without. It is this power of adaptation or acclimatization which enables the inhabitant of the Faroe Islands to live upon putrefying flesh without suffering anything more than ordinary diarrhœa unless during epidemic visitations; which accounts for the fact that the native of tropical malarious districts can reside in the vicinity of the swamp which is fatal to the European stranger; which long made French physicians regard the enteric fever of Paris as a disease peculiar to the strangers visiting that city; and which enables many medical men, nurses, and hospital servants to pass years in the midst of infection with impunity.

But whatever opinion may be entertained with regard to civic miasm as an exciting cause, its influence as a predisponent cannot be questioned, both as rendering the constitution more liable to zymotic diseases in general, and as determining their special complications. The histories of the epidemics of zymotic diseases of the present day abundantly prove this, as do the descriptions given by Hecker and others of the abounding filth of the persons and dwellings of the English during the epidemic periods of the middle ages, and the evident causal relation between the diseases and these conditions.

In such cases we frequently find that a period of deranged health precedes the outbreak of fever, characterized by gastric derangement, headache, languor, and unhealthy secretions; and observations made by medical men at different times and in different places have shown that in this premonitory stage the blood undergoes a change recognisable by the microscope, the red corpuscles being broken up and the serum tinged by their contents.*

Dr. Grimshaw has adduced abundant proof of the power

* This fact, first observed by Dr. Petter of Baltimore, and again by Dr. Cormack, in the Edinburgh relapsing fever of 1843, has been more recently recognised and described by Dr. Hand of Philadelphia. Dr. Hand relates a case in which the blood was examined within three or four hours of the first seizure and found to be in an average state of degeneration. The case proved a typical one of relapsing fever. Dr. Hand believes that by living in a contaminated atmosphere the blood

of *ochlesis*, or the poison generated in crowded collections of human beings, with insufficient supply of pure air, to generate and diffuse the contagium of typhus. That this poison may be generated *de novo* under certain conditions I entertain no doubt, but that ochlesis more frequently acts as a predisponent to zymotic diseases in general, and to exanthematous typhus more especially is probable.

Examples are to be found in the histories of the famine fever of 1847 and 1848 detailed in Sir William Wilde's able and elaborate Census Report of that period, they are also to be found in the cholera reports of the Board of Health and Privy Council, and in the Army Medical Reports of cholera in India.

Perhaps no more striking example of its *preventable* nature could be cited than that afforded by the *trismus nascentium*, formerly so fatal to newborn infants in the London workhouses, and in the great lying-in hospital of this city, and still so in Iceland.

In the lying-in hospital the deaths within the first fortnight after birth formerly amounted to 1 in every 6 children. The improved system of ventilation adopted by Dr. Joseph Clarke reduced this proportion to 1 in 19½. Under Dr. Collins' mastership this was reduced to 1 in 450 and under the present master, Dr. George Johnston, it has been further reduced to little over 1 in 500.

In Iceland, under opposite hygienic conditions, we learn that during twenty years ending in 1847, 64 per cent. of the infants born alive died of *trismus* from the fifth to the twelfth day after birth.

The immediate effects of overcrowding and deficient ventilation are (*a*) diminished proportion of oxygen in the respired air, (*b*) diminished oxidation of tissue, and consequently continually increasing amount of decomposing nitrogenous matters in the respired air and in the blood; but in times of war and famine other conditions co-operate. With regard to the latter, Dr. Carpenter observes:—

"We have not merely that general depression of the vital powers which is a predisposing cause of almost any kind of malady, and pre-eminently so of zymotic diseases, but also the presence of a large amount of disintegrating matter in the blood and general system which forms the most favourable nidus possible for the reception and multiplication of such poisons. And thus it hap-

may become thus changed without fever necessarily following. This was noted in the case of four of the resident medical attendants of the Philadelphia Hospital.—*New York Medical Journal*—quoted in *British and Foreign Med. Chirurgl. Review*, Oct., 1870.

pens that pestilential diseases most certainly follow in the wake of a famine, and carry off a far greater number than perish from actual starvation."*

Such was the case in the Irish famine of 1846–7 the effects of which are thus graphically described by an eyewitness—Dr. Donovan of Skibbereen. "'In a short time the face and limbs became frightfully emaciated; the eyes acquired a most peculiar stare; the skin exhaled a peculiar and offensive fœtor, and was covered with a brownish filthy coating, almost as indelible as varnish. This I was at first inclined to regard as incrusted filth, but further experience has convinced me that it is a secretion poured out from the exhalents on the surface of the body. The sufferer tottered in walking like a drunken man; his voice became weak like that of a person in cholera; he whined like a child, and burst into tears on the slightest occasion. As regards the mental faculties their prostration kept pace with the general wreck; in many a state of imbecility, in some almost complete idiotism,'" &c.†

The highest degree of predisposition of which the living body is susceptible is generated by the crowding together in gaols, workhouses, or hospitals of human beings in the condition above described, as is proved by the annals of the epidemic of 1847–8 already referred to.

Fatigue and exhaustion caused by prolonged or excessive bodily and mental exercise is one of the most powerful predisponents to zymotic disease. We see its influence in the persons of anxious relatives who succumb to infection when exhausted by long watching; and it is witnessed in the case of cholera in soldiers exhausted by long marches in a hot climate, more especially if conjoined with intemperance in the use of spirits. Under such combined conditions we have increased disintegration of muscular tissue, involving an increased accumulation in the blood of carbonized and nitrogenous products in a state of progress to decomposition, and diminished oxidation of effete tissue due to imperfect respiration, and to the superior attraction of the alcohol for oxygen—heat and alcohol here acting under Dr. Carpenter's third catagory, namely, by obstructing the elimination of the products of disintegration of muscular tissue already augmented by excessive exertion.

We are indebted to the Rev. Professor Haughton for the remarkable observation that the amount of nitrogenous products of metamorphosis of tissue from mental work exceeds that accruing from bodily labour in the proportion of 533 grains to 400 grains of urea excreted daily.

* "Principles of Physiology," sixth edition.
† *Dublin Medical Press*, vol. xix, page 67.

He also states that "whenever an abnormal amount of these products is excreted the cause must be ill health, and most generally that most fatal of all diseases to which man is liable, anxiety of mind, a vague and unscientific expression," says Dr. Haughton, "which, however, denotes a real disease."*

There may be said to be two distinct modes of action of mental, or more properly speaking emotional, predisposing causes, viz., by long continued strain and by sudden shock. Carking care, anxiety, and despondency act in the former manner as true predisponents; sudden and violent emotions of grief, shame, and terror act in the latter, and may be more properly termed determining causes.

Both exercise a powerful influence on the molecular nutrition as we have already seen in the case of the first; a striking example of the influence of terror on this function is thus narrated by Mr. Carter:—"A lady who was watching her little child at play saw a heavy sash fall upon its hand cutting off three of the fingers, and she was so much overcome by fright and distress as to be unable to render it any assistance. A surgeon was speedily obtained, who having dressed the wounds turned himself to the mother, whom he found seated moaning and complaining of pain in her hand. On examination, three fingers corresponding to those injured in the child were found to be swollen and inflamed, though they had ailed nothing prior to the accident. In four-and-twenty hours incisions were made into them, and pus was evacuated, sloughs were afterwards discharged and the wounds subsequently healed."†

It is well known that under the influence of strong emotion the blood and secretions will undergo important changes, the surface will become pallid, or it may be suffused with bile, the mother's milk will become a deadly poison to the infant at the breast, and in many cases of fever recorded by Sir H. Marsh, Dr. Law, and others, in which such emotion has been the *determining* cause the entire course of the disease has been characterized not only by severe nervous symptoms but also by marked changes in the blood, and lesions of the function of nutrition.

The conclusions which I think we may draw from the facts which I have adduced, are the following:—

I. That liability to zymotic disease is inherent in our constitution, involved so to speak in the function of nutrition.

* *Dublin Quarterly Journal of Medical Science*, vol. 30.
† On Hysteria, quoted by Dr. Carpenter.

II. That it varies in degree in different individuals, and in the same individual at different times and under different conditions, partly external or extrinsic, partly internal or intrinsic, some of which are preventable and others non-preventable in their nature.

III. That, *ceteris paribus,* this liability is least in those persons in whom healthy blood, healthy tissues, and healthy excretions, and a healthy state of the nervous system constitute a healthy nutrition.

IV. That is greatest in those whose blood contains the largest amount of the products of waste of the tissues, or of matters in a state of decomposition introduced into the circulation from without.

V. That all scientific hygienic measures are based upon their power of preserving or restoring the healthy condition of the factors of nutrition and neutralizing the conditions, whether extrinsic or intrinsic, by which this function is impaired or deranged.

VII.—*On Antiseptics and Disinfection.* A Lecture delivered by ROBERT MACDONNELL, Esq., M.D., F.R.S., Surgeon to Dr. Steevens' Hospital.

THE impurities existing in the atmosphere which surrounds us are partly gaseous, and in part minute but solid particles of matter.

The gaseous impurities which render air more or less deleterious, such as the carbonic acid gas which accumulates in a crowded room, or the sulphuretted hydrogen which emanates from the sewer are detected by chemical agents. Chemistry has taught us how to recognise these impurities and how to remove them. Many gaseous impurities in the air we detect by the sense of smell, but some being inodorous can only be proved to exist in it by chemical re-agents. When, therefore, we remove disagreeable smells, and so far purify air as to cause it no longer to be offensive to our nostrils, it by no means follows that it is thereby rendered healthful and pure.

It is a dangerous delusion to repose trust in that class of agents called "deodorants"; they are very useful in their way when their true use is comprehended; in so far as they render air less disagreeable to our noses they are good; if thereby we are induced to suppose that the air is purified and rendered wholesome we are led into error. It must ever be borne in mind that no chemical disinfectants can supply the place of cleanliness, ventilation, and drainage.

But it is not to the gaseous impurities of the air we breathe that I desire at present to direct attention. It is to the other class of impurities of which I have spoken: the exquisitely minute but solid matter in suspension in the air; the almost inconceivably fine dust which dances in the sunbeam, and is borne across the ocean by the storm.

The offensive gases given off from decomposing organic matter are usually either ammonia or compounds of hydrogen with carbon, sulphur, or phosphorus. Such impurities as these are absolutely invisible. Thanks to the marvellous delicacy of the means of investigation introduced through the influence of light, we are now enabled to render visible the dust, minute though it be, which floats in our atmosphere.

The dust, or if you will, the dirt of the air, is of course very complex and very varied in its composition; it is not exactly alike in the flax or cotton mill and over the threshing machine, in the crowded theatre and the hospital ward. It is however everywhere composed of the débris of organic as well as inorganic matter; but along with this pulverised débris of lifeless matter there is reason to believe that there exist minute spores, germs, or seeds, which being borne by the gentlest draft of air from place to place, are as capable of germinating and growing as the thistle down or the dandelion seed, if chance bears them to a suitable soil.

According to an analysis made by Dr. Percy, the dust collected from the British Museum contains fully 50 per cent. of inorganic matter. No doubt most of this is mineral matter, worn off from the streets and houses of London, and matter carried forth from factory chimneys. The débris thrown off in the cotton mill, or by the gradual wear and tear of our clothes, carpets, the surface of our bodies, or at the brushing of our hair, &c., &c., &c., is organic matter, but it is lifeless; it is not capable as the minute germs or spores are of growing, and so of calling into play any of that remarkable series of changes which we are familiar with, as accompanying the growth and development of such plants as the yeast plant or vinegar plant.

Although, then, these minute seeds, germs, or spores form, in all probability, a very small part of the atmospheric dust compared to the lifeless organic or inorganic débris, they are, nevertheless, on account of their active properties, and of the wonderful changes (fermentations, decompositions), they are capable of calling into existence, in certain fluids beyond all comparison, the most important and influential agents present in the dust of the air.

The lecturer now exhibited to the audience the well-known experiments of Professor Tyndall, showing how large a portion of the dust of the air is really of organic origin. In an electric beam, which powerfully illuminated the dust of the theatre, an ignited spirit lamp was placed. Above and around the flame were seen wreaths of darkness resembling an intensely black smoke. But this blackness was proved not to be smoke, for a similar blackness was produced by a hydrogen flame from which no carbon could pass away, and a red hot poker placed beneath the beam gave rise to a similar phenomenon. Moreover, when real smoke was allowed to rise across the beam, so far from giving rise to wreaths of darkness, it caused clouds of snowy whiteness.

The darkness then is not smoke, it is simply that of

stellar space: the organic particles floating in the beam being destroyed by the heat, there is no longer anything to catch and reflect the light. The vacant space is darkness, rendered visible by contrast.

Having exhibited a variety of experiments, as set forth by Professor Tyndall, to illustrate this subject, the lecturer proceeded to say:—After such evidence as is now before us no one can doubt the large quantity of organic filth which, in the shape of dust, loads the atmosphere of cities, nor is the country free from its pollution. Even far out at sea, and on the summits of mountains, these light bodies may be met with.

A phial of perfectly pure, newly-fallen snow, was taken from the summit of Mont Blanc, by Dr. Kolbe, and brought to M. Pouchet. On melting it it yielded about one cubic inch of water, which was to all appearance pure and clear. But a slight deposit was observed in it on standing, and this deposit contained the following substances:—A few minute bodies of a mineral nature, two woollen filaments, one white and one blue, a fragment of a confervoid plant, a minute tuft of vegetable air tubes, and a dozen young cells of Protococcus Nivalis. Thus we find that the force of the wind may bear, even to the Alpine summits, dust containing mineral matter, organic matter, and spores.

As regards the "germ theory" of disease, and as it may be called the "germ or putrefaction theory" of suppuration, science owes much to discussion arising upon a very different topic—viz., that of "spontaneous generation." Two able disputants arose in M. Pasteur and M. Pouchet, whose investigations, although undertaken with quite another object, have yielded a rich harvest in this field.

M. Pouchet declared that all his examinations showed the atmosphere to be everywhere poor in organic germs, and often entirely destitute of them; and that its capacity for generating animal life resided not in these germs, but in the general vivifying power of the air. M. Pasteur, on the other hand, insisted that the chemical constitution of the air remaining the same, its power of producing organic life varied with the locality from which it was taken; and this because the number of germs contained in it varied in different places.

Both the disputants stated their positions in definite terms. M. Pouchet said, "I assert that from whatever region of the globe I take a quantity of atmospheric air, if this air be placed in contact with a putrescible liquid in hermetically-sealed vessels, the liquid will invariably become filled with living organisms."

M. Pasteur said, "It is always possible to obtain in a particular locality a notable volume of atmospheric air which, without having been subject to any physical or chemical modification, is nevertheless incapable of exciting any change whatever in a putrescible liquid." These assertions, emanating from two eminent observers, both members of the Academy, were so diametrically opposed to each other, that it was agreed to refer them to a Committee, in whose presence the requisite experiments should be performed, and who should report to the Academy on the result. Such a Committee, composed of five members, was accordingly formed, and entered upon its labours in June, 1864, in the Chemical Laboratory of the Museum of Natural History, at the Garden of Plants.

M. Pasteur first presented three of his flasks which had been filled with air four years previously on the Montanvert, and had remained ever since perfectly unchanged. One of them was opened under mercury, and the air which it contained, on being analyzed, was found to have the natural constitution of the atmosphere (twenty-one parts of oxygen to seventy-nine parts of nitrogen). Another flask was opened by a minute orifice at the neck, and after being left for three days exposed to the atmosphere, it contained flakes of a cryptogamic vegetable growth, which subsequently became largely developed.

M. Pasteur then prepared and sealed, before the Committee, sixty flasks, similar to those previously used. Nineteen of them, after cooling, were opened and immediately resealed in the amphitheatre of the Museum; nineteen on the top of the dome of the same building, and eighteen others at a country-house a few miles from Paris, under a thick growth of poplars. Afterwards microscopic vegetations were developed in five flasks of the first set, six of the second, and sixteen of the third. All the remainder were unchanged at the end of over four months.

The Committee subsequently reported the result of their experiments, and gave as a conclusion that the facts observed by M. Pasteur, and contested by M. Pouchet, were of the most absolute exactitude.

It thus seems to have been placed beyond a doubt that the atmosphere is incapable, from its chemical constitution alone, of exciting organic growth in a boiled infusion; but that it often introduces with it into the solution invisible germs which have this effect, the proportion in which these germs are present varying with the locality from which the air is derived.

But up to this time the dispersion of organic germs in the

atmosphere was not an actually observed fact, but only a probable inference from the results of experiments like the above. This is what gave a certain weight to the objection of M. Pouchet when he said in one of his communications, "It seems to me that when an experimenter declares that he can collect from the atmosphere either the eggs or spores of microscopic organisms, we have a right to demand that he should show them to us."

No one, in fact, had succeeded in collecting these germs from the air in any abundance, in such a form as to be visible and recognised.

This, however, was accomplished by Dr. Lemaire in 1864. He adopted the plan of condensing the vapours of the atmosphere in glass tubes by means of artificial cold. The moisture thus obtained was then kept in the tubes, well stoppered, together with an equal or double volume of air, at a temperature of from 73° to 86° Fahr. The collections were made in the month of July, from a marshy neighbourhood in the country, from the Garden of Plants in Paris, and from a village near the city, situated at two or three hundred feet higher elevation. The liquid, when first condensed, was colorless and limpid. It contained microscopic vegetable germs or spores; a great number of pale cells, of different dimensions; a considerable abundance of very small semi-transparent bodies (thought to be the germs of future infusoria) of a spherical, ovoid, or cylindrical shape, sometimes regular and sometimes irregular; certain brownish corpuscles, apparently of vegetable origin; starch-grains, dust-particles, and cubical crystals. Within twenty-four hours afterwards there were developed an abundance of living infusoria, bacteria, vibrios, spirilla, and monads, together with ramified cryptogamic vegetations. Exactly in proportion as the cryptogamic vegetations and the infusoria were developed, the spores and the small semi-transparent corpuscles were found to disappear.

Thus the actual existence of organic germs in the atmosphere was demonstrated; and there could no longer be any doubt that these germs, when introduced into an organic infusion, are abundantly sufficient to account for the production of infusorial and vegetative life.

The Lecturer, in order to enable his audience more accurately to comprehend the exact form of M. Pasteur's experiment, exhibited the mode of hermetically sealing up flasks containing fermentable liquid.

M. Pasteur took glass flasks filled partially with a clear infusion of brewer's yeast. He then boiled the fluid, and while ebullition was going on actively drew out the necks of

the flasks to a narrow point and sealed them over the flame of a blow-pipe. The fermentable liquid was thus enclosed in an air-tight vessel containing nothing save its own rarified vapour. Upon cutting off the neck of the flask in any particular place, the air of that place rushed in to fill the vacant space. The flask being then resealed the effect of this air and (of such germs as it might happen to carry in along with it) upon the liquid could be observed.

He prepared sixty of these flasks. Twenty of them were afterwards opened and resealed in the country at the foot of the first plateau of the Jura range. Twenty others were opened and resealed on one of the Jura mountains, two thousand five hundred feet above the level of the sea, and the remaining twenty near the "Mer de Glace" Glacier, at an altitude of six thousand feet. The result was that of the first twenty flasks, eight were found afterwards to have produced living organisms; of those filled with air from a point two thousand five hundred feet above the sea level, five showed similar productions; while of those filled at the "Mer de Glace" one only became the seat of organic life.

We see then that the air of our large cities is loaded with dust in part either mineral or lifeless organic débris, but partly composed of matter in the shape of germs or spores capable under certain circumstances of starting into organic life and growth. Nor is the air of the country or the mountain top quite free. Although ordinary light permits this dust to escape our observation, a strong beam causes it to become a real visible existence; painfully real when we come to contemplate with the aid of the electric beam the fine filth which we every moment draw into our lungs. It is, however, quite certain that air so laden with dust of one kind or another as to be positively irritating to the air passages, and even capable of gradually developing diseases peculiar to certain trades is not necessarily charged with that kind of matter "living dust," as Professor Lister aptly calls it, which is so very deadly to man; which in fact is conceived in the present day to be the means of propagating epidemic disease. The question is what is this portion so virulent in its nature, so mysterious in its development, so terrible in its attacks upon mankind? The current theory some time ago concerning epidemic diseases was that they were propagated by a kind of malaria consisting of organic matter in a state of motor-decay, and that such matter entering the body spread there the destroying process which had attacked itself. This theory was exactly analogous to that held with regard to the supposed action

of yeast. A little leaven leavened the whole lump. The discovery made by Cagniard de la Tour in 1836, and independently by Schwann of Berlin in 1837, altered the views of chemists with regard to the theory of fermentation, and gradually altered the view hitherto taken as to the causation of epidemic diseases. By the discovery of the "Yeast plant," a living organism capable of feeding, growing, reproducing itself, fermentation was proved to be a product of life, not a process of decay; a decomposition if you will, but a decomposition caused by the energy of growth and life. As regards fermentation the minds of chemists, influenced by the authority of Gay-Lussac for a time ascribed putrefaction to the action of oxygen, and retained the idea of matter in a state of decay. Pasteur however finally exploded this notion. He proved that the so-called ferments are not such; but that the true ferments are organized beings which find in the reputed ferments their food. Side by side with these researches and discoveries concerning ferments and fermentation has run the "germ theory" of disease. It is true that it is in a great degree an hypothesis based upon analogy, and every philosopher will admit that in such matters analogy may be but a deceitful guide. It has however received much strengthening and support from various scientific observations. Unconsciously perhaps the mind is prepared to accept such a theory by learning the strange history of the invasion of the minute entozoon known as the "Trichina spiralis." Dr. J. Burdon Saunderson's experimental inquiries relating to the nature of infective agents has done much in the same direction. The researches of this able observer go to show that in all infective inflammations in the lower animals microzymes (microscopic organisms) abound in the exudation liquids; and that the same forms are to be found in the blood of animals when in the state of acute infective fever.

To turn, however, from these refined scientific observations and ingenious theories to their practical application, the question is, how can we best escape the dangers which beset us on every side from the living organic impurities of the atmosphere? Obviously by seeking to free the air from these impurities.

As to "*deodorants*," the risk of trusting to them simply has been already spoken of, they have, however, a recognised value. Various kinds of charcoal (peat charcoal, boghead coke, &c.), quicklime, chloride of lime, a variety of metallic salts, dry earth, &c., have the power of either removing by their absorbing power offensive gases or of

breaking them up by their chemical action. Ammonia, and several of the compounds of hydrogen, with carbon, sulphur, or phosphorus, not unfrequently given off by decomposing animal matter, may thus be got rid of.

True disinfectants or oxydizers of organic matter are more valuable as well as safer. The fumes of nitric and nitrous acids, the manganates and permangates of soda and potash, chlorine gas, &c., are powerful oxydizers, and quick lime, and chloride of lime owe in fact their deodorizing qualities to the same cause.

Antiseptics, or those bodies which restrain or absolutely prevent decomposition, are in many respects the most important. Disinfectants oxydize the products of decomposition; antiseptics prevent the formation of any such products. The ordinary processes of cooking, pickling, tanning, &c., are to some extent antiseptic processes. Various metallic salts, sulphurous acid, creasote, and carbolic acid have remarkable antiseptic powers. Small quantities of the last named acid added to an organic solution completely prevent the growth of those organisms which cause, or at least accompany, decomposition. The careful use of it has been found to produce the best results in the treatment of open wounds. It seems to kill the "living dust," which, penetrating along with the air into open wounds, causes the blood to rot and the system to be infected by a poison thus generated within itself.

The whole range of modern scientific research does not possibly offer a more charming illustration than this topic of the antiseptic treatment of wounds of how science and practice work hand in hand for the benefit of mankind.

When the philosophers of Bologna discovered and investigated the elementary phenomena of galvanism they little thought that in the starting muscles of a dead frog's limb lay the germ of that which would one day bind the remotest corners of the earth together with telegraph wires. The discoverer of formic acid little dreamed at the moment that chloroform and its accompanying blessings lay hid in his discovery. Pasteur, Pouchet, Tyndall, and many others now see in the practical application of Professor Lister the benefits arising to mankind from purely scientific investigation, undertaken in fact with a view to elucidate questions of a very different nature. Professor Lister, of Edinburgh, combining in himself the rare qualification of the acuteness of the man of science, the skill of the experimenter, and the dexterity of the surgeon, has based on a scientific foundation a mode of practice which disarms of their dangers many of the worst injuries and the gravest operations.

VIII.—*The Prevention of Artizans' Diseases.* A Lecture by E. D. Mapother, M.D., Professor of Physiology, Royal College of Surgeons, Medical Officer of Health, and Surgeon to St. Vincent's Hospital, Dublin.

The industrial classes of Dublin, according to the Census just issued, number 50,943, or over one-fifth of our population, and as they are usually the bread-winners of families, widespread poverty must follow their loss of health. The cheerfulness which accompanies manual labour, with its ample and regular reward, and the dignified feeling that the artisan works for those at home whom he loves, are highly conducive to health. There are, however, many employments at present pursued under cruel conditions, which legislation and good feeling on the part of the employers may remove or mitigate. The richer classes should not forget that they owe their comforts and luxuries to artisans, and that our country's prosperity depends on their well-being, and that of the generations to succeed them. For such reasons I feel sure of your sympathy, whilst I detail in a way, which must needs be dry and fragmentary, some plans for the prevention of the ills incidental to their labour. Workpeople will themselves most advantageously find out precautionary measures as soon as, by the diffusion of the knowledge of physiology, they learn to set a proper value upon health. The endeavour to teach them this knowledge is not new in Dublin, for I find that 46 years ago a course of lectures on artisans' health was delivered in the Mechanics' Hall by my earliest professional friend, Dr. M'Keever.

The special diseases which ill regulated trades promote may be arranged in three classes:—1. Those due to the entrance of dust into the lungs. 2. Those due to slow poisoning. 3. Those which constrained positions or overwork in close rooms engender.

I. The millions of little waving hairs which coat our air passages resist dust for a long time, but increasing attacks from without at last tire them. Steel-grinders suffer most severely from the entrance of particles into their lungs. The average duration of life at Sheffield among forkmakers, who work exclusively at a dry stone, is but 29 years; those who make scissors last 32 years, the rougher work being done with a wet stone; and sawgrinders live on till 38, wet stones being alone used. Just as desire for promotion makes the soldier hail the battle, these men show a desperate

disregard for all precautions, and freely declare that if life were prolonged the employment would become overstocked, and wages consequently lowered. In Ireland wet grinding is alone employed, and that on a very small scale. As in the case of many other unhealthy occupations, safeguards should be enforced under the supervision of inspectors, or of the proprietors, who are often willing to do their duty in this respect. Magnetized wire respirators and magnets hung through the rooms effectually catch the iron dust, which is given off very largely; for instance, a razor loses half an ounce in being shaped from the rough. Professor Sigerson has figured these and other dust from various workplaces, and I show you some of his diagrams. The eyes are sometimes protected by spectacles, and the need for this is shown by the fact that in a few months the glasses get opaque from particles imbedded while red hot. The grinders have to shape the stone rough from the quarry, and this should be done in the open air. A flue and fan would carry off the dust if each stone was boxed round, except at one point for working. One proprietor (Mr. Rogers) by such appliances has prolonged the lives of dry grinders to 46, and of wet grinders to 49 years. While the hair of the head is worn so long that it catches dust, that natural protective, the beard, is shorn by the workmen in this and many other dusty trades. Nature, by denying this dust filter to women, indicated that they should be exempted from labour at dusty occupations.

Stonecutters suffer from one-third more sickness than carpenters. This lung, taken from the body of one, contains stony particles and gray dust, which have set up slow inflammation. Instead of a pink, fleecy, and spongy mass, it has become black and tough, like Indian-rubber. The French stone with which the millstones of all countries are made, is, as you see by these specimens, so very hard and flinty that the chisel has to be sharpened every 20 minutes. It is largely worked in Dublin, and the men cannot stand the breathing of its chips more than eight years, although they suffer little for the first three or four. The very intelligent gentleman who conducts this business in Dublin has often to force his men to go to the more harmless occupation of cutting ordinary stone; but as they earn up to £3 weekly by piecework, they reluctantly consent, notwithstanding the danger to their lives. One London employer confesses to the killing of ninety men during the forty years he has carried on business.

Metal miners die by lung diseases in England in a pro-

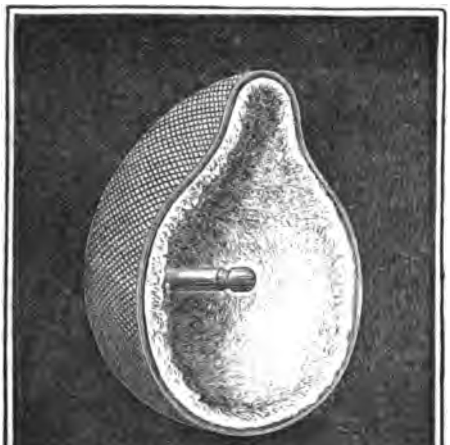
portion nine times greater than the agricultural population; and as 1,075 deaths from accidents occurred among the 370,881 coal miners of Great Britain in 1871, it would appear that underground trades eclipse those pursued above ground as much in risk as they do in discomfort. Any of us who will cramp his body under a table some two feet high for half an hour, will understand what the collier may have to endure while for many hours he squats thus in the dark, and works hard with the pickaxe meanwhile. His day's labour over, he drags his body up the shaft, from a temperature beyond our summer heat to the darkness and chilliness of night, to descend again—at least during half the year—before daylight dawns next day. It is no wonder, therefore, that his lung is stuffed with dust, and burst from his efforts in breathing, or that his body is stiffened from such a posture and rheumatic chills. At the top of the shafts at the coal mines at Valenciennes, and those of Lady Bassett, in Cornwall, there are baths and comfortable rooms for change of clothes. They should be universal; and let us hope that if our mining operations should extend, inspection will be established and these appliances introduced in Ireland. Double shafts, or aspirators, and steam man-lifts, should be in every mine insisted on; the former have improved health and prevented explosions, and the latter have greatly lessened heart disease. There is an undue proportion of lung illness among the 421 coalheavers and the 101 sweeps of Dublin.

Pottery workers are subject, in a great degree, to lung disease, the more so since some technical improvements have rendered a stoppage of work during frost unnecessary. There is now need for greater sanitary vigilance. The dust rises mainly from the floor, and the workrooms should be swept, after proper sprinkling, at least every morning before the operatives begin. I am happy to say that our Irish pottery at Belleek, where over 600 hands are employed, excels in the healthfulness, as much as it does in the beauty of its work.

Textile fabrics of many kinds have their victims, the working of flax being the most hurtful. Dr. Greenhow reported to the Privy Council, that in one factory at Pateley Bridge, Yorkshire, 23 out of 27 who hackled flax were habitually asthmatical. Anyone going into the hackling or carding rooms of a flax factory coughs and sneezes violently. Machinery has almost entirely displaced hackling and wool combing by hand—the latter, formerly done in the worker's dwelling, was hurtful to every inmate. The machine boys,

aged from 13 to 18 years, suffer much from dust, or "pouce," as it is called, in the Belfast flax mills; while those who do not begin work till they are adults, bear the dusty work very well. Among others, what is called "mill fever" arises, and as it has a peculiar rash, and occurs but once in life, it is not unlike the eruptive fevers. At paper works, the teasing of the shoddy, at hemp dressers (a large industry in Dublin), and at marine stores the picking of rags, create a most stifling and hurtful dust. This is also the case in feather stores, as the roguish rustics overweight their pluckings with lime and dust.

The remedies for dusty trades are palpable enough. 1. To filter the air by a respirator. This one, which I devised more than three years ago, was found very effectual; but as those who showed regard for health and life by wearing it were laughed at by their fellow-workmen, it has been abandoned. You see it consists of a wire gauze covering the mouth and nose, lined by a layer of cotton wool, ¼ inch thick.



If the lining be thicker it flushes and heats the wearer. It is held by a piece of wood caught between the teeth, and thus the nose, our natural respirator, must be used for breathing. Mr. Pearson, of Ship-street, makes them for a few pence. If female workers wore bonnets or caps, with crape strings fixed across the mouth, much dust would be excluded. Dr. C. D. Purdon has invented a respirator, which Messrs. Grattan, of Belfast, sell for 13*s.* 6*d.* a dozen. It is made of buckram and cotton wadding, and is

held on by two loops of elastic round the ears. Excellent results have followed its use in flax mills, potteries, and in Ward's great paper factory. 2. Ventilation by M'Kinnel's tubes or Archimedean tops, which I show you, or other special plans. Fine glass tubes are said to catch organic matter from the air passing through them, and a combination of such tubes might make a good ventilator between workrooms. 3. The action of steam fans, which in large factories have proved their efficacy by the increased appetite of all hands. Well arranged means for heating must be combined. In a Nottingham factory, heated by badly set hot air pipes, 190 out of the 200 hands were attacked with bronchitis. 4. The exclusion from all labour, requiring vigorous muscular and breathing efforts, of persons under 18, whose organs up to that are not tough enough to resist ill-usage. (Tyndall's experiments with dust in the air and sections of artisans' diseased lungs were then shown by the electric light.)

II. The second class includes those trades which lead to slow poisoning. Lead has long been the painters' bane; but since the introduction of zinc paints and the more general use of paper for the walls of parlours and halls, its ill effects are less frequently seen. Mr. Price, of the Midland Railway, finds that paint in which iron is substituted for white-lead is better for painting iron work. As the salts of lead are not volatile, it must be from the hands the poison is brought to the mouth, especially when food is being eaten. The metal gives a warning, for the gums "hoist a blue Peter" in the form of a lead coloured line along their edges. When this sign appears the workmen should have nothing to do with lead for a week or two. I believe this blue line, as well as the other coloured lines from copper, mercury, and other metals, to be due to the reduction of the metal by light, for it does not appear round the back teeth, which are kept in the dark. The sugar in the mouth helps the reduction. The other ill effects of the poison are great weakness from spoiling of the albuminous matters of the blood and paralysis of the muscles on the back of the forearms, especially in painters and plumbers. This selection of the part is probably owing to the lead getting in through little breaks in the skin of the hands, as is proved by file makers, who fix the tool on a bed of lead, with the forefinger getting palsied there; and the potters who handle lead glaze suffering also in the forearms. Many painters are wholly disabled, and, consequently, pauperized. The muscle of the heart is amongst those which lead

specially weakens. Great mortality used to follow the grinding of white-lead; but now that a moist process is substituted, little harm results, and lead-mining is the only occupation in which the poison actually kills. At Reeth, in Yorkshire, where half the men are lead-miners, the deaths by lung diseases are double those of the agricultural population. Women who work at lead seldom, if ever, bear children. The sweeping of the rooms, the floors being previously wetted very early in the morning, saves many work-people. I am happy to say I find that the workpeople at Ballycorus lead works are most healthy, owing to perfect airiness, and the avoidance of cleansing flues on windy days, when dust would affect the men greatly. The preventives of lead poisoning are numerous and efficient:—1. Washing the hands and mouth frequently, and always before meals. I have known painters who have thus escaped during twenty years' work. Those who live far away from their work suffer most, as they take their meals without ablution. The addition of a few drops of sulphuric acid to the water in which the hands and mouth are washed would be a further preventive. 2. Ten drops of this acid to a pint of water makes a pleasant drink, which, by changing the lead into the most insoluble form, has checked poisoning in many lead works. Milk is also especially useful, by quickly renewing the albuminous matters in the blood which the metal spoils. Fermented liquors are remarkably injurious, as they lead to the fixing of the metal around the joints, and thus produce a kind of gout. 3. The wearing of a linen suit, which should be washed weekly. Last month a painter was in St. Vincent's Hospital for palsy of the lower limbs, which had resulted from his habit of washing the paint from his garments while they were on him. 4. The taking of a bath at least once a week. Metallic poisons tend to the skin especially, as is best shown in the case of silver. Five grains of nitrate of silver taken internally have dyed the whole skin gray, and the metal, therefore, cannot be equally distributed in the body. The Turkish bath, in which the skin is longest exposed to the action of light, would probably reduce the metal most effectually. 5. The lead colours should be mixed with the oil, or turpentine, in a machine something like a churn. 6. Painters in burning off old paint must inhale a good deal of lead. I have found that brushing over old paint with carbolic acid strips it thoroughly off, and the injurious scraping of the wood is avoided. 7. If painters with "dropped wrists" are mad enough to work on, an Indian-rubber strap from a glove on

the hand to the coat above the elbow will give some help to the wasted muscles. It may be feared that painters and plumbers will not understand and value preventive measures, but I have always found them a particularly intelligent class, and of the 1,968 in Dublin, only 1-19th are unable to read and write. Printers suffer occasionally from lead, especially if type is delivered to them wet, when absorption rapidly occurs. If the "composing stick" is kept too full of type, weakness of the forearm muscles may follow. The antimony of the type appears to cause the profuse perspiration, slow pulse, and depression which they labour under occasionally. A few years ago the deaths among London printers between the ages of 35 and 55 were twice as numerous as among men of similar ages generally, but for this closeness of workrooms and overwork were to blame more than the effects of metals. On one Sunday newspaper the compositors had often to work, without a break, from Thursday morning to Saturday evening. The rooms were usually ventilated by windows which were rarely opened, as the draught made the gas-flame flicker, and as there was sure to be found among the men (as there so often is in a railway carriage) one so selfish and stupid as to insist on all the windows being shut. The workrooms of Dublin printers are better, but if they were more frequently whitewashed they would be more lightsome and cheerful. Roof ventilation should be universal. As in too many other trades the men are often idle for the earlier part of the week, and overworked for the latter part; masters should absolutely prevent this.

Copper among braziers and those who work with copper paints is the cause of great weakness, spitting of blood, and other distressing chest symptoms. A marone line round the gums, discovered by Sir D. Corrigan, forewarns of the danger. Some years ago I attended a fatal case of copper poisoning in St. Vincent's Hospital. The lad was wholly employed at scraping the old green paint from Venetian blinds and mixing the fresh colour. The pigment is Olympian green, or carbonate of copper, and a respirator and a mixing machine would render these processes harmless. As I have before stated, carbolic acid would strip the paint as fully as the use of sandpaper. Chrome green is a safe substitute for the copper colour. Braziers should never place the brass articles in their mouths, which they frequently do. Zinc rises in very dense fumes in brass foundries, and the workmen are often seized with an illness like ague, which obliges them to cease work for a few days. The casting should be done in the open air, or under well-arranged flues

Mercury is the most hurtful of all the metals, and miners, mirror makers, and gilders, who have to deal with it, lead lives inconceivably miserable. Constant salivation, low spirits, great weakness, and shaking palsy are almost universal; and cases have been recorded in which the limbs were so disabled that food had to be taken by the mouth as quadrupeds take it. Loss of mind has also resulted; and truly looking-glasses would reflect many a sad face if the sufferings of those who made them were remembered. Electricity has rendered gilding with the aid of mercury obsolete, and the making of mirrors from nitrate of silver, now so general in France, should abolish all the horrors of mercurial labour. You will see that this silvered mirror, which I got in Paris in January last, is as brilliant and perfect as could be; and moreover, it is cheaper and more lasting than the mercurial ones. The process of Petitjean, by which it was made, throws down the silver by ammonia and tartaric acid. The cost for silvering is only 1*s.* 8*d.* per square yard—one-third less than the deadly process by mercury. In England three processes have been invented —that of Drayton, using oil of cassia; that of Thomson and Mellish, which employs grape sugar; and that by which the specula of many telescopes are silvered, milk sugar being the reducing agent for the silver. The full details of the last three are given in "Cooley's Cyclopedia" (fifth edition), and I trust they may be studied and adopted by our mirror makers, whom I have found most anxious for means to render their trade less hurtful. If mercury is still to be used, the following are practicable measures for the mitigation of its evils:—1. Peculiarly liable persons should be excluded from work. Physicians know that a few grains of mercurial preparations will in some produce fierce effects, while others seem almost insusceptible of their action. 2. The work should be only allowed for two or three days in the week. 3. As the poison tends to the skin, baths are highly preventive, and the workmen of Negretti, the barometer maker, by a daily bath avoid all illness. 4. Flues and fans should be so arranged that all vapour and dust must be carried off. An idea of the quantity emitted in the workroom may be gained from the fact that one manufacturer recovered 20 lbs. of mercury by a single sweeping of his chimney. The dust would be also caught by double casing to the walls, the inner being pierced by holes. The mercury could be thus saved. 5. Milk and eggs should enter largely into the diet of the workers, for they neutralize the effects of the poison. Sulphur, taken internally, would also change the metal to

the sulphide, the least active of its salts. 6. The use of the respirator previously described. 7. A linen suit should cover the whole body, except the face and hands. 8. At the factory at St. Gobain, sprinkling the floor and walls with ammonia is said to have been highly preventive. At the government establishment in the Rue St. Denis I saw last January much disease, and few precautionary steps.

Arsenic in the form of Scheele's or emerald green, is the cause of great suffering to workpeople, to those who live in rooms coloured with it, and to those who breathe it in from certain ball dresses and wreaths. I show you wall papers sold in Boston, London, and our own city, which contain this arsenite of copper largely. Up to 70 grains per square foot, or 1 lb. of arsenic in the papering of an average room have been found in some specimens. Such paper, when brushed over with ammonia, turns a bright blue, owing to the copper, and this is a readily applied and fairly reliable test, or the burning of a bit of it gives a strong garlic odour. Artificial flower makers suffer severe and even fatal illnesses from this emerald green—painful rashes, sore eyes, sickness of stomach, and great weakness, being the symptoms. The remedies are very clear—1. The sale of this poison should be restricted as white arsenic is, and all arsenical papers and articles of dresses should be marked "poisonous." 2. Work should be occasional—that is, other work should alternate with the dangerous one. 3. The work should be done at a table pierced with holes, through which the surplus powder would fall, and it might be collected in drawers below. As dust diffuses itself so thoroughly, as you have seen, any antidotal substances for arsenic would meet it in the air. 4. The hands should be frequently washed with water containing one-tenth of hydrochloric acid. The dangers from arsenical ball costumes any of us may encounter. A wreath coloured with it contained 40 grains; 3 oz. have been taken from a tarlatan dress by Professor Nichols, of Boston, and 60 grains were proved to have been thrown off from another dress in one evening's wear. If many belles were dressed thus in a crowded ballroom there would be, indeed, a "dance of death." In the Emerald Isle it is a favourite colour, as one may best judge at a Patrick's ball. It is to be hoped that some more natural and harmless tint of green will become fashionable, for thus alone will dangers from arsenical colours cease. Those who are loyal to the rival colour do not escape; for the common orange dye, chromate of lead, has lately caused numerous cases of poisoning.

Gas makers suffer in many towns from the noxious effluvia

given off by the refuse lime, and from excessive perspiration, unless gruel be used freely as a drink. The amount of perspiration given out by a workman in the retort-house is twenty times over the usual rate. In our gasworks the iron process has been, at my suggestion, adopted by the company, and most signal advantages have followed to the workmen and the citizens who live near. Matchmakers—or, to avoid an ambiguous term, I should rather say workers in phosphorus—number but 11 in Dublin; and all work in a well-conducted factory in Ardee-row. A small over-crowded dwelling-room was used for this purpose six years ago in Ball's-lane; but, after my evidence of injury to health, it was abandoned. Phosphorus in the English factories used to cause painful, and even fatal disease of the lower jaw; and that substance so saturated the workers that their clothes, for many days after leaving off work, were luminous in the dark. Preventive measures have been so far successful that, in the great Manchester factory, no disease has resulted since 1863, whereas, for the previous twenty years of its work, most distressing results were observed. The essential steps for prevention are—1. To forbid the dipping or mixing of the phosphorus compound in any room into which the other more numerous workers have access. 2. To forbid the taking of meals without washing the hands, or in any room, save that for cutting wood, as is prohibited by the Factory Act, 1864. 3. The exclusion from work of those who have bad teeth, for thus the poison reaches the jaw. 4. The wearing of a respirator, such as I have described, the cotton being wet with a solution of potash, to catch the fumes. 5. The hanging of cloths, soaked in turpentine, which would absorb the vaporized phosphorus. 6. And above all, the exclusive use of amorphous phosphorus, the red powder made by exposing common phosphorus to a heat of 400 degrees for some weeks. It does not vaporize, and is, therefore, harmless to workmen. Bryant and May use this; and further, they place it on the box, the match being tipped with a composition containing chlorate of potash. As the matches light only on the box, risk of fire is greatly lessened.

As regards the tobacco trade, cleanliness, ventilation, and the use of a respirator, would greatly lessen the weakness, functional heart diseases, and extraordinary complexions, which greatly trouble the workers. Their time of work should be short, with frequent intermissions. Rolland's torrefier is used in France, to the great advantage of the workpeople.

III. Those diseases which constrained positions or over-

work in close rooms engender. The baker suffers from the entrance of dust into his lungs, but more from the circumstances just named. In Dublin in 1859 his work hours averaged seventeen, beginning on Sunday afternoon about four o'clock, and he slept usually on the empty sacks, or in a bedroom over the bake-house, where the carbonic acid of the air was excessive. For a wonder, Ireland was for once before England in sanitary legislation, as regards the baker, the 1 and 2 Vic., chap. 28, prohibiting any baking process on Sunday, except the setting of Monday's sponge. Dr. Guy, of King's College, London, described several of the bake-houses in the metropolis as underground, without daylight, pervaded by sulphurous and worse smells, often flooded, and overrun with rats. One was not high enough for a man five feet nine to stand erect in. It was no wonder that one-third of the London bakers habitually spat blood. Good example in Scotch towns, and in Belfast, and dignified agitation, procured the Bake-house Act, 1863, which provides for the frequent cleaning of the premises, a wholesome sleeping-room, and the exclusion from work, between 9 P.M. and 5 A.M., of all lads under eighteen. Unfortunately the carrying out of the Act is not left to the Factory Inspectors, and I fear it is much neglected in some towns. The evils of the night-work are still deplorable, and if the men took nights alternately in setting the sponge, the other journeymen surely could be spared between the afternoon and four the next morning. Some years ago I found hours in flour mills even more exacting, the dust more hurtful, and there was Sunday labour in those worked by water. Last week one of our newspapers had a letter, signed "A White Slave," which complained that in small confectionery shops the female bakers had to work over thirteen hours daily, and in dark cellars most usually.

Shoemakers nearly all work in their single dwelling-room, and by the piece, the family often giving aid. They inflict excessive hours on themselves—often from six in the morning till midnight—alleging that they would be dismissed if work is not returned at a certain hour, however unreasonable. Some of them idle every Monday or Tuesday. Their stooping posture, with the work pressed against the stomach, confinement in close rooms for so many hours, and their poor diet, consisting largely of tea, render them the most dyspeptic of all artisans. The circumstances of our weavers are very similar.

The tailor's posture on the floor, with the legs crossed and the head bent down, must be injurious, and apprentices

always complain of it. I feel sure the amount of apoplexy is excessive among the men in this trade; and giddiness on first rising up after long work is very common. A man sitting in this posture breathes with much less than half the vigour of a man walking at the rate of three miles an hour; and therefore we find that their deaths (many of which are by consumption) exceed those of agricultural labourers of similar ages by two-fifths. The breastbone of tailors is often bent greatly backwards. A six-inch seat and a foot high table, with semicircular notches at the edge, would afford a far more healthy posture for work, and would seem to the uninitiated just as handy. Nearly all the tailoring workrooms while the Workshop Act was carried out by the Corporation were found to be very fair, and in those which were not, amendment followed prosecution. Previously the hours were excessive, and midnight on Saturday was often encroached on. In 1864, Dr. E. Smith, of the English Local Government Board, reported as follows of sixteen of the most important West End tailoring shops:—"The cubic space in these ill-ventilated rooms allowed to each operative and the gaslight only 156 feet per man. . . . In another room, which can only be called a kennel, in a yard lighted from the roof and ventilated by a small skylight opening, five to six men work in a space of 112 cubic feet per man." The outwork system, which is often known by a term more sensational and less polite, "the sweating system," is in force with some of the second-rate tailors in Dublin. Its alleged advantages are that the man's wife and family may work and add to the earnings, and that exorbitant charges on the part of shop workers and strikes are prevented. Its evident evils are the withdrawal of the wife from household duty and of the children from school, the temptation to work at night and on Sundays, and the possible conveyance of contagious diseases from the families of the workpeople to those of the customers. It is further alleged that dissolute workmen, unable to get respectable employment, are taken into the rooms of families who are able to get work, which they thus sublet. I think you will agree with me that the evil outweighs all possible good.

Next we must consider the seamstress' case, and more briefly than the topic deserves. The Government Inspector in 1864 reported that in one London collar-making establishment, in which 400 females were employed, the proprietor confessed "that the handworkers could only get imperfect nutrition upon the low rate of wages (9*s*.), and said that they did not get meat more than occasionally, replacing it

by some highly flavoured substance which would enable them to swallow the staple article of their food—dry bread. The dinners of the girls, which he had noted with some care, would consist often of a pennyworth of pickles and a pennyworth of bread." What must be the lot of their Dublin sisters, whose wages range from 3*s.* to 7*s.*, to meet prices now one-third higher? That low prices paid for articles of ladies' dress account for this rate of wages few husbands or fathers present will allow. Where, therefore, does the money go to? While the Public Health Committee carried out the Workshop Act there were many prosecutions for overcrowding of dressmakers' rooms. In one case 22 girls were packed in a room which allowed but 136 cubic feet space for each of them, or less than half the lowest amount for healthy breathing. Weakness of sight, from over use of the eyes with ill-arranged light, and indigestion from bad and hasty meals and long sitting in a close room, are diseases which every hospital and dispensary physician has commonly observed amongst needle-workers, who number in Dublin 7,552. Such ills can be readily obviated by having the light high above their heads, moderating daylight by pasting green tissue paper over the upper panes of the windows, and giving variety in the colours of the materials to be sewed. Regulation of work hours will be presently considered. To the habit of giving orders immediately before great balls or shows, and to the increasing dressiness of the period, deplorable overwork is often due. Would that the fair sex understood that their admirers would value their sympathy with the poor seamstress far above splendour of attire. The sewing machine has surely served the needle-worker, and no harm results if the work be not continued for more than five hours unbroken. Toil with the feet has led to illness from undue supply of blood to the lower half of the body; but if all hands were taught the machine, rest and work by turns could be allotted to all. Steam and an ingenious magnetic apparatus have been substituted for foot work at Salem, Massachusetts, and Hall's and Parson's treadles (of which I show you figures) have been advised for the lessening of this labour by the Board of Health of that State.

Overwork of the fingers has also its ill consequences, as these casts of the cramped state of scrivener's hands will show you. The posture, too, with the spine twisted and the face bent down, as if the nose were to be used as a pen, has injured clerks and school pupils. A seat with a back to it and properly arranged light would set all these evils at naught, if

the hours were not unduly protracted. Too constant work with the letter stamp and with the hedge shears has produced a contraction somewhat similar to the cramp of scriveners. Constrained positions in the open air are more hurtful than the most muscular labour under the same circumstances, and thus the drivers of vehicles and watchmen suffer from bronchitis and rheumatism to a much greater degree than farm labourers, and consumption is readily promoted in those subject to it.

My hour is nearly exhausted, and, therefore, I must omit much which might be said about other trades, and end by enumerating the measures which are desirable, and, I trust, gradually attainable for the improvement of the health of our working-classes. 1. Reasonable hours of work, to be regulated by factory inspectors, of whom there are but two in Ireland. Enthusiastic and untiring as Mr. Astley is, his visits cannot be frequent enough over the factories and workshops of more than half our island. The Factory Acts loudly call for codification, or at least assimilation—for instance, in that regulating workshops there is no power to enforce the keeping of a registry of workpeople on which their ages and time of beginning and ending work can be seen, or the posting of the regulations of the workshop. Again, it is not certain if meal time is allowable to those who work less than twelve hours daily. A medical certificate of age, and, what is more reliable, of fitness for work, should be required from every workshop operative, as it is from every factory worker. I trust that shop attendants will share the advantages of such measures by the passing of Sir J. Lubbock's Shop Regulation Bill now before Parliament. During the forty years of their operation such statutes have conferred enormous benefits. The manager of a Bradford factory reports that forty-five years ago his father carried him on his back to work at five in the morning, and that, except half an hour for meals he laboured till eight at night. Then factory girls were so tired at night that they had not energy enough to take off their clothes when they reached their homes, and flat foot, in-knee, and curved spine were common among the youths of both sexes. 2. Occasional vacations in the more dusty and the lead and mercury occupations would do much to obviate their evils. A month in the year, a week in the quarter, or a half holiday in the middle of the week, would be the most useful periods for various trades, and in many cases agricultural or household work could very beneficially occupy the artisans meanwhile. If employment failed—an event inevitable in all trades—poverty would

not result if these occasional intervals had been well used. No full holiday is declared in the Workshop Act. In Dublin the Saturday half holiday has not been highly valued, but by permission of the inspector any other day may be substituted, and Wednesday being near the middle of the week, would be the most appropriate day. 3. Meals are partaken of by artisans very irregularly. If their dwellings happen to be near their place of work, it is better that the open air in going to and coming from dinner should be employed, and economy and social intercourse are usually promoted by the taking of this meal at home. Those dressmakers who live far away from their parents are often content with bread as a mid-day meal to support their toiling bodies. For such the provision of a dinner like that supplied to the assistants in all our great drapers' shops would be a most useful and not necessarily an extravagant step. If such refreshment rooms as that in South George's-street were multiplied the object would be achieved in another way. I must allow that the failure of the Workman's Hall in Kevin-street has discouraged many friends of the working classes.

The employment of married women in factories, who number in the United Kingdom a quarter of a million, and in workrooms, is for evident reasons deplorable, and at all events infants should not be deserted by their mothers till six months of age. Half the children born in the Staffordshire potteries die within the first two years, and over one-tenth of the deaths are due to burns and drowning. The fault mainly lies with the husbands, who are not manly enough to work hard and avoid the tavern, and thus keep their wives at home. Dr. Baker, Chief Factory Inspector, tells us of the wondrous blessings the Factory Acts have achieved, "without an atom of personal, commercial, or national wrong." If the time for labour has been shortened, the pay has advanced, our exportation of textile fabrics has enormously increased, and the operatives are more intellectual owing to the leisure afforded them. That moral safeguards are called for will appear from another extract from his last report:— "An intimate acquaintance with the working classes for 40 years and more (38 of which have been official)—their habits their language, the certainty of their early induction into vice from the admixtures of the sexes, the disregard of parental control by the young from the sudden independence of wages, and the means thus afforded of injurious indulgences enables me to speak on these topics with some authority, and only confirms what might have been anticipated from

the employment of boys and girls and men and women together, without any moral supervision. To these causes may also be added, the one sleeping-room of the homes of so many of them, the adolescents washing and dressing in the presence of each other, the unsexing nature of so many of the employments, such as foundries, furnaces, and brickyards; and the drunkenness and bad examples of many of the parents, all of which have operated, and are still operating, to produce a lamentable state of immorality amongst them."

Baths free or very cheap are sadly needed in several of the more crowded parts of the city. Ablution is much neglected by artisans, and one sees them in the galleries of theatres as sooty and grimy as when they left work. Excursions and walks on the Sunday afternoon do much to preserve the artisan's health, and proximity of sea and mountain makes Dublin of all cities that in which they can be more readily enjoyed, especially as we have now the tramways. Too many of the labouring class spend the greater part of the Sabbath and the Monday idly in bed or in drinking. Employers should punish all those who absent themselves on Monday. Social economies, such as savings banks and Government assurances and annuities, which are so much safer than "Friendly Societies," do much for the mental quiet, and, therefore, bodily health of the working classes. The opening up of our squares would prove a great blessing to the children of the working classes. Again, there are many spaces now disused or covered with ruins, which, if levelled and planted with a few trees and grass, would make capital recreation grounds. For example, the Cabbage Garden, Long-lane; the spaces between Patrick's Close and Bull-alley; between Great Elbow-lane and Gill-square; between the rere of the Adelaide Hospital and Golden-lane; and on the north side, Newgate. The demolition of many tenements utterly beyond repair, and the substitution of decent dwellings for the industrial classes in the city or in the suburbs, connected with it by cheap tramways, are among the most pressing requirements of the day. Our taxation, which, for water supply and main drainage, has provided, or must provide three-quarters of a million for the twelve years (1864–75), can scarcely bear unusual expenditure for some years to come. Our city is, however, conspicuous for the generosity of its prince merchants, and benevolence could scarcely find more worthy objects than those I have hastily indicated.

IX.—*On the Construction of Dwellings, with a View to their Sanitary Arrangements.* A Lecture by GEORGE C. HENDERSON, Architect.

THE construction of dwellings with regard to their sanitary condition is the subject which it has fallen to my lot to bring under your notice; and the questions involved have lately been so thoroughly discussed, whether in the public journals, or in the more strictly speaking architectural and engineering publications, that I feel it would be quite impossible for me to say anything new, unless, indeed, I were to propound some Quixotic, crude, and untried theories of my own; but it seems to me the purposes of this lecture will be best fulfilled by a review of some of the best known maxims, and by calling attention to the proper application of the modern patents and inventions of sanitary engineers, and the subject being one of grave importance I much wish that the task of elucidating it had devolved on abler and more experienced shoulders than mine.

Before going into any details, I would preface my remarks by saying, that though we are bound to follow in the march of civilization, and as we should each, whether by original invention or the application of improvements, endeavour to improve the sanitary condition of our neighbours, we likewise ought to use our discretion in these matters, and not allow ourselves to be carried away by each article that appears in a *popular magazine*, for as fault-finding is easy to the scientific mind, it is only when remedies are sought, that the first *difficulties of the new* and the *perfections of the old systems* will appear; and though we must thank the Prince of Wales's illness for many sanitary improvements, we must also remember that many of the suggestions on sanitary matters made since are only good on paper.

Again I must ask you to bear in mind, that people do not always practise what they preach, for this simple reason: that to carry the precept into effect generally costs more than it is the practice to expend in this country; for what at the present day is the ordinary history of a dwelling-house

from the time of its first conception until its final accomplishment?

Mr. A goes to architect B. I require, he says, so many reception and bed rooms of such-and-such a size, besides servants' apartments and stabling, and my limit of expenditure is so-and-so; all to be done in best manner with latest improvements. Mr. B, the architect, suggests he does not think it can be done for the money. Oh, says A, "Sharp" got his house for £1,000 less; it is quite as large and very handsome. Well, when the tenders for the work come in they are too high, and then the reductions commence, one by one the improvements are lopped off; in fact, Mr. A must have the quart put into the pint bottle, and as he will not hear of the reception-rooms, or elevation being reduced, for fear they would be inferior to his friend Sharp's, the contract is closed for the building without any of the latest improvements.

What I wish to lay before you is what a house should be, irrespective of cost; and *any dwelling to be healthful must be well drained and dry; must have an ample supply of water, as without this, from want of flushing, the best drains will become defective; it must also be well ventilated and heated.*

In considering the present subject, the denomination *dwellings* must be divided into *three* heads:

1stly. The country seat.
2ndly. The town or suburban residence.
3rdly. The artisan's or operative's house.

The site for a country house should be chosen with great care. A fine view is doubtless a great inducement to select a certain spot, but many good houses have been rendered uncomfortable by being placed in exposed positions; the ground selected should itself be elevated, and if it be commanded by higher lands, the arterial drainage from them should be diverted so as not to pass near the proposed building; and the plantings or natural undulations of the ground, if there be any, should be made available as a shelter from the west and south-westerly winds, which blowing almost constantly in this country are so charged with damp that they penetrate the most substantial walling, and are, therefore, more to be dreaded by the builder than the easterly winds, prevalent only during the spring months.

The next consideration is the plan of the house; this must of course be in accordance with the requirements of the family; in all cases, however, attention must be paid to the position of the various apartments: for instance, breakfast-

rooms should have the morning sun, which passing westward ought next to strike the drawing-room, &c., while in libraries or billiard-rooms, the eye prefers a strong light without the glare of the sun's rays; again nurseries and dressing-rooms require the sunlight in preference to ordinary bed-rooms, and all sculleries, lavatories, &c., should have direct light and ventilation, through the outer walls; and if there be any fall in the ground, the kitchen should be placed at the lowest point for reasons that will be hereafter explained, and it will be found a great advantage to have the kitchen and offices outside the house and only one story high. The plan being agreed upon, next comes the drainage or sewerage. Now I have often heard people condemn drains and call houses unhealthy because the sewage only discharged into a cesspool. Do such persons ever consider what they are saying, and do they remember that there are not corporations and main drainage schemes all over the country? Now suppose, as they will probably suggest, we discharge our sewers into the adjacent stream; well as this supplies our neighbour next below with water for domestic use he may not think it a neighbourly act, and having got, say, Dr. Cameron to analyze it, may go to law with you, under some of the recent Acts against the pollution of streams (the operation of which will, I hope, soon be extended to Ireland). Now how do we stand? We have no public main, we can't go into the river, our neighbour won't let us, and neither will science, which says we must save all the sewage for the farm; so what is to be done? Build a good tank, and decide upon its situation at once; this should be as far away from and as far below the water supply for house as circumstances will permit. Now the main sewer should be laid in, making sure that you have a good fall; pipes certainly make the best drain, and the best of them I have seen are known as Jennings' patent, as they admit of examination by simply removing one of the collars; the lower half of the collar should be laid in cement, and the upper half should be bedded in common brick clay, known by builders as "puddle." A soft water cistern should next be constructed under ground, close to, but on the lower side of the house.

Both these tanks should have overflows, and if these overflows can be run into the garden they will be found useful for the purposes of irrigation, &c.

The use of large sized sewer pipes is a great mistake. People reason that as a building is large so it requires large sewers. You will at once see the fallacy of this argument when you consider that the sewage does not lodge in the

pipes, but only passes through them, and the smaller the pipe the better the flush; so, therefore, it is the soil-tank or receptacle that should be made proportionate to the number of the inmates and not the bore of the drains, and for ordinary establishments a 9-inch main with 6-inch branches will be found sufficient.

I believe the best system of sewerage to consist of *three* distinct lines of drain pipes: the *first* taking the soil from house necessaries, scullery, and stables, &c., direct to tank; the *second* will take the water from bath-rooms, wash-houses, &c., and should be connected with the overflow from soil-tank; the *third* row will connect with the stack-pipes and convey the rain-water to the soft water cistern. Each of these drains should, close to the tanks, be provided with syphon-traps, with stand-pipes carried to surface of ground, and protected by stone with perforated metal cover, hinged; this has a twofold use: 1st, if any gases are generated in the tanks they will escape here by the stand-pipe instead of entering the house; and 2ndly, should any stoppage occur in the drains it will most probably be at this point where it can easily be removed.

The water supply is a part of our subject on which little can be said in a lecture, as the circumstances vary so in each case; above all, however, this portion of the work and the arterial drainage should be left in the hands of a civil engineer with permission to consult an analyst as to the purity of the water. Practically the main house supply must always be derived from either wells or local rivers, and, if possible, should be taken from such a level that, with a ball-cock, it will fill the house cisterns; or if the water have to be taken from a low level, if a stream serve, it can be used to turn a turbine-wheel. Now as many people have a mistaken idea that a turbine, like the hydraulic-ram, of itself actually forces the water up, I may remark that it only produces the motive power to work pumps which can draw from a well of filtered water, whereas the ram is a pump that can only raise the same water it is worked by. All water, whether hard or soft, should be filtered before it enters the dwelling, both on sanitary grounds and to prevent, as far as possible, deposit in the cisterns and incrustations on the pipes. A filter bed can be formed at the end of any tank by placing divisions across it; these form compartments to be filled with various beds of coarse and fine sand and animal charcoal, through which the water percolates into the tank. These filter beds should be periodically cleaned out and renewed.

The main cistern should be placed at the highest possible point in the house, but still in an accessible position, and should be of large size, say containing sufficient water to meet two days' consumption should any accident occur to the supply pipes. The consumption of water in Dublin at present is about 40 gallons per head per day, but Mr. Neville hopes to reduce this to about 30 gallons; and, taking this as a fair average, a family of *six* persons will require a cistern-area, as nearly as possible 6 feet long, 4 feet wide, and 2 feet 6 inches deep, containing in round numbers 375 gallons, weighing, as nearly as possible, 33½ cwt. exclusive of the cisterns; so it will be seen that some substantial bearers are required for the main cisterns. From the main cistern all the minor supplies should be taken to the lower levels, by which means the small service cisterns will always remain full.

The foundations demand special care. When the trenches have been carefully opened, and the level applied to see that, though practically level, there is a slight fall to one point, then the masonry may be commenced in the ordinary way, building the first course of large stones laid crossways to the wall and without mortar; from this rubble work may be carried up to the finish level of ground; and here I may mention that basements, properly so called, on sanitary grounds are not desirable. Houses having basement stories are, I am aware, usually spoken of as particularly dry; too often, however, this has only reference to the family or upper portions of the house, while the kitchens and servants' apartments will unheeded exhibit ground-damp to a large extent. Now, I believe our great ancestors were *as* alive to the unpleasantnesses of a damp dwelling as we are, and that, therefore, they built vaults under and round their houses to secure dry lodgings over; and in the olden days, when wines were kept on draught, tho beer and cider made at home, and falconry, bear hunting, and cock fighting, were popular, doubtless good uses could be made of the subterranean apartments as stores and kennels for the "pets." As time crept on, however, the old form of building was often followed, but I believe the original use of the basement was lost sight of, and probably from want of accommodation for the retainers on the upper floors, the underground story first became a human habitation, and so the practice has been handed down from generation to generation to the present time when the introduction of basement floors is on most sites to be discouraged: 1st, they tend to dwarf the building, and so

lessen the effect of the elevation. 2ndly, the story under, or half under, ground costs quite as much as a similar amount of work above the surface. 3rdly, in carrying off the drainage from the building, the excavation will be so deep, and the cost of removing any obstruction that may occur, consequently so great, that I for one would consider this alone a fatal objection; besides all this however, modern manufactures properly applied enable us to dispense with the basement, for what I set out as *its first use*, namely, to prevent damp rising, from a naturally wet soil or badly drained foundations, into the walls of our habitations; for this purpose a course of some substance perfectly impervious to water should be laid on all walls, say three inches over the ground. The various materials used are: slates or flags bedded in cement, bricks laid in the same material, coal-tar, felt bedded in coal-tar, perforated terro-metallic ware, and asphalte. To *most* of these there are objections; slates and flags are so brittle that if not very carefully laid they break with the superincumbent weight, and so become useless; *bricks* will absorb about one-fifteenth of their own weight of water, that is to say, a solid red-brick when soaked will be about seven ounces heavier than when it came out of the kiln; and if any one side of a brick be kept wet the moisture will soak through it, and even communicate with anything that may be in contact with the other side, and constant wet, helped by frost, will eventually rot even the best qualities; we therefore see that the brick is of little use, and that the non-conducting agent in this case is the cement which is as brittle as the slate, and therefore open to the same objections. Coal-tar is a very desirable material, and the cost so trifling that it is to be regretted it is not more generally adopted; in large buildings however, where the weight is great, tar alone is liable to be displaced, amd hence *two* courses of felt, each bedded in coal-tar, are constantly used in this country with satisfactory results; but as *felt* exposed to the weather rapidly becomes porous, I believe it alone would be useless as a dampcourse. The tiles are made of various thicknesses, and of widths to suit all walls, and being glazed are impervious, so that wet can only ascend through the joints; the tiles will bear great pressure, and it has been urged in their favour that as a means of ventilation they are good; that may be so for a storehouse, &c., but I am inclined to think such a volume of air under a floor as would pass through a course of these would be rather unmanageable.

I would much prefer asphalte, say one inch thick, to any other dampcourse, as it can be laid without any jointings,

and is possessed of an elasticity that in a great measure does away with the risk of fracture. This course being finished, a drain from the trenches containing foundations must be constructed to carry off the surface water, or that accumulating from springs should such unfortunately appear; for this purpose the common field drain-pipe, or an ordinary ridge tile, laid in loose stones with proper falls will be found efficacious; this drain should discharge into a small reservoir, which can be readily formed by sinking an old barrel, which a fireclay pipe trapped by one of the syphons above mentioned, should connect with the overflows from soil and soft water tanks.

Having so far described the progress of a house we find at least a good system of sewerage, and a dry bed on which to raise the superstructure; we will now watch the building more as the critic than the constructor, suggesting what ought, and what ought not to be done. We see the ground floor joists laid; below them, and just above the damp-course, one or two pieces of perforated metal will be placed under each room; this it is asserted is to give ventilation and so preserve the timbers—a laudable effort, doubtless; but if these opens be exposed to a strong wind, will not the cold air passing through the floors, lower the temperature, and produce draughts in the rooms over? Now, how is this to be avoided? Well, before answering this question, I would ask you to remark that while I maintain all ventilation should, as far as possible, be self-acting, I also desire that it should be under complete control. To prevent the cold rising through the floors, and the carpets becoming like small balloons partially inflated, as I have seen in suburban houses, I recommend the floors to be double, or counter floored, the space between the boards being filled in with, if near the sea-side, dry sea-sand; if inland, dry sawdust. Next, these ventilators should be made to open and close, and as iron would, by rust, soon become fixed, it seems to me that something of a like form, made of brass, copper, or zinc, would best serve the purpose.

Now it is from the spaces under the floors to which a constant current of air can be admitted, that I believe the main supply should be brought into the house by flues, carried up to the backs of the fireplaces in each room, where there should be a chamber formed in terra-cotta or fire-clay (air passing over hot metals becomes unhealthy); here the air will become warmed, and from thence it can be conveyed into the apartment at any convenient point in the chimney-stack, the opening by which it is introduced should be

fitted with a regulating valve; for if too much air be admitted below, or if the fire in the grate be strong, the current passing into the room will require adjustment; and as these air-shafts terminate below the point where the ordinary smoke-flue from the fireplace commences, it will be seen that there must be space for them in any building. It may be said that this system will only work where firing is used. Not so; a very small rise in temperature will rarify air, and put it in motion, and I believe that if any smoke-flue in a stack of chimneys be in use, it will generate sufficient heat to work all the ventilating shafts leading to the rooms over. Again, this is but a small objection, for if in July or August you are warm, if the walls of a room were honeycombed with ventilators of various sorts, it would be hard to persuade my hearers that any of them worked half so well as the simple, but of late much abused open window. In winter time the case is different, and the popular want is thorough ventilation, without cold draughts, *when* the temperature is low; and I submit for your consideration a well-known system that can be economically, and, I believe, effectually carried out in new houses.

In old houses a good and simple mode of introducing cold air into the apartment consists of having a deep slip along the sill of the sash on the inside, which allows the window to open say two inches from the bottom, and so admits the air into the apartment by the meeting rail.

Ventilation, however, cannot be good unless the foul air be carried off in about the same proportion as the fresh is supplied. The accomplishment of this is full of difficulties. We know that most of the means in use are defective, but who can point out the right course to adopt? We will examine carefully the ordinary appliances:—One of these, known as Arnott's or Sherrington's Patents, is to be found in almost every modern house, near the ceilings of the principal rooms, sometimes fixed in the exterior walls, with perforations on the outer face, sometimes fixed communicating with the chimney. Arnold's Patent is a nicely balanced valve, supposed to permit the exit of all foul air, &c., while the income draughts caused by wind close the ventilator, which can also be closed at will by a cord attached to a lever. They are undoubtedly good in principle, and the best of their kind I have seen: lately I introduced one into a chimney; there was no direct return smoke, but the draught being bad, sufficient soot escaped to blacken the ceiling in a few weeks; again, when fixed in an outer wall, in spite of the cork-buffer, the noise is sometimes so great that

I have known them closed up altogether, for people will not use anything that annoys them. These Sherrington's are perfectly simple, but require constant attention, while Arnott's only require attention when objectionable, and are therefore greatly to be preferred.

Another common practice is to leave an opening over the chandeliers, in the centre of the room, where a box is formed from which a pipe is taken through the outer wall, and generally turned up; while the temperature of the room is high, the chandelier burning, and the outer air calm, the bad gases *will* escape through the tube, but if the wind be high a return draught is to be feared, and when the temperature in the apartment is low, and but a small fire burning, there will nearly always be a direct current from this air-shaft to the fireplace. As a proof of this, I may mention that the sunlight burner, now so much used in our public buildings, when unlit, has been found to produce such strong currents of air across the heads of an audience that they are now generally fitted with "Mercury Floats," patented by the Messrs. Strode, of London; their name almost explains the working; when the gas is unlit there is no passage for the income or exit of air; light the burner, and the heat by expansion raises the float, and permits of the escape of foul air and the products of combustion; other appliances having the same object might be noticed, but we must return to our subject. In passing I may, however, remark that the sunlight in operation is founded on exactly the same principle as M'Kennell's ventilator, explained in Dr. Mapother's lecture. Small flues are also often carried up in the chimney stacks, starting just below the ceiling level, and they generally discharge a little over the slating; in the main, I believe this to be a good system, but I would like to have the ventilators carried the full height of the chimney stack; if, however, the flue be terminated near the ridge of the building, there should be an opening left on both sides of the chimney, so that if the wind strike one side the air may escape by the other. In buildings where there are large assemblages, or in public asylums, this system can be developed by carrying a number of small flues into a main shaft in which a current of air is maintained by the use of fire heat, or even a jet of gas kept constantly burning. The objection urged against the use of these flue-ventilators is that if the temperature in an apartment without a fire be raised, say by gas, to any moderate degree, air will enter the room by the chimney, coming down from exactly the point the foul-air shafts discharge at, and therefore it is asserted

some of the poisonous gases will be reintroduced into the house. With all respect for the writers who hold this theory, I think it a little far-fetched; for we may take it as the broad rule that it is the tendency of all bad or unwholesome air to ascend. Therefore if it once gets to the top of a chimney, I don't see why it should or how it could immediately rush down the next flue, and even supposing it possible, it would be greatly diluted by fresh air and so be harmless, and if there be a register (as there should be) to the grate, the escape into the room will be almost nil; and further, I believe that down draught in chimneys is mainly caused by an insufficient supply of air in the apartment, and if the cause be removed the objection will also vanish.

Another mode of ventilation consists of a panel hung on pivots over the doors, or of sliding perforated panels in the doors; these have been much discussed of late, and as they communicate invariably with the interior of the house, they bring us to consider whether passages or the stairs should or should not be used as ventilation shafts; for my part I think not, for as there are two currents in every doorway—through the lower half, air entering the apartment—through the upper half, air rushing out in an impure state, then ascending by the stairs—the supply on each floor would become more and more fœtid; we should not therefore turn more bad air into the stairs than we can help, and the air in passages should be kept pure by the same means as suggested for the rooms. Many more details connected with ventilation might be discussed with interest, but the last I will touch upon has reference to the plumber's work. Many are the theories as to the proper mode of connecting the interior drains with the exterior already described. Here again these syphons come to our aid, for in this position from a stand-pipe a few inches from the wall of our house we are able for the last time to ventilate our sewer; but in all cases let it be remembered that the lead or soil pipe should come through the walls to the outside; but as to whether soil-pipes should be fixed inside or outside, I believe it to be quite immaterial provided all the joints be made in solder, and that these pipes be provided with ventilating tubes which may be connected with the main shaft rising from the sewer which should be carried to discharge at the highest point of the building, if possible in some tourelle or gable, away from the chimneys carrying the ventilation flues from rooms. The various pans and basins should be fitted with S traps in preference to those known as the D form of trap, which I am glad to say is now almost out of

date. Penetrating a little further into that labyrinth of pipes to be found in a house well fitted and supplied with *soft water*, pump water for general use, and hot water, we find under the bath-cocks, the cleaning screws in traps of lavatories and butler's pantries, &c., little leaden trays placed to receive any leakages that may occur, and also in the cisterns we have what are called stand-pipes; they serve as overflows, and should also screw out at the bottom, so as to allow of the cisterns being thoroughly cleaned. All these pipes are connected with some one of the drains and are seldom trapped, and indeed trapping would be almost useless, for unless filled with water a trap ceases to be a trap; and through many of these pipes, used only as precautions, water never runs, consequently they should not be introduced into a soil-pipe; they may be connected with the service-pipe of a water-closet, but the waste of a bath should be chosen in preference, and it will be better still if they are run into one of the rain-water pipes.

I believe the junction of these rain-water, or stack-pipes as they are called, with the main sewers now alone requires notice. If the separate drains, such as I have described, be used, all that will be required is to let the water discharge on the surface of the ground into a dished stone, in which is fixed a metal trap connected with the drain-pipe; these traps, besides taking the surface water, catch the sand and other deposits washed off the roof, and can easily be cleaned out.

Heating I must only briefly touch upon; and if we ever give up our open fireplaces and adopt stoves or other means of heating I believe the time is so far distant that such a contingency need not now be considered seriously. In speaking of ventilation a means of heating the air entering the apartments has been referred to in connexion with the ordinary grates, and with a view to procuring a uniform temperature through the dwelling, and a consequent reduction in the consumption of fuel, as well as a diminution in the risk of colds from draughts, &c. It will be found that the hall, or lowest point of the stairs, is in practice, the position to which the greatest amount of heat should be supplied, as from thence it will diffuse itself through the other passages, and so into the various apartments. A large supply of hot air might be derived from a chamber formed behind the kitchen range, and distributed by flues through the house, and if a stove be used for the hall the well-known "Musgrave" still holds the highest position, followed perhaps by the "Gurney." Hot water, however, should be the

means of heating aimed at, and not given up without a struggle: 1st, because the warmth generated is more wholesome and also more pleasant to the senses than that produced in any other way I know of except the open grate.

2ndly. Because if the house be not very large and a close range be used for the cooking the heat can be obtained without an extra fire; and here comes in the reason (promised in the early part of this lecture) for putting the kitchen at a lower level than the rest of the house: it is to enable us to make use of the fire in warming the water for the general supply of the house, as well as for heating purposes, as the boiler for any circulating apparatus must be at a lower level than the pipes; as the water when heated flows out at the top of the boiler and returns cool to the lower portion, many people use the same boiler to supply the house and heat the coil of pipes placed, say in the hall; so far as my experience goes I have not found this work well, as the heat is seldom sufficiently strong; I have however used with success twin boilers, which in winter, when required for heating purposes, work independently, and in the summer season can, by stop-cocks, be both turned on to the bath supply.

The Genus gas-stove has doubtless been much improved upon lately, but they are still in their infancy, and very undesirable if used without flues.

If time permitted there are many items in a house that might be usefully discussed; but I must now leave this very imperfect notice of the country residence, and pass to the considerations in connexion with town and suburban residences; here the tide of fashion hardly leaves us the choice of selection in our site, as too often the speculative builder builds in a rising locality, and the public are content to pay him a high per-centage for his outlay. To the affluent about to build in or near a town I would say that most of my remarks already made regarding foundations, dampcourses, ventilation, and heating will equally apply to their case; but as the main sewers are in these positions generally found ready made, the question of drainage is much simplified. To persons of moderate means I would say, *do* not build unless you can do it in the best manner; if you cannot afford it this, or next, year, wait until you have more money saved; in the meantime, if you or indeed any of my audience think your rented house unhealthy or the drainage bad, do not vex or worry yourself until, through very fear, you become ill, but get some practical man to examine the house for you, when I venture to say that by the expenditure

of a very few pounds, in the manner suggested by him, most probably in putting only a ventilating tube to the soil-pipe, you will have as healthy a dwelling as any cheap house built by some common builder to your own special order. If your house be cold, and there be any fireplaces in the inner walls, by resetting the grates, you can have a chamber formed at the back, which fitted with a simple sliding valve below and above, the heat will cause a draught, by which a supply of heated air will be supplied to the adjacent room or passage.

Here I must remark that though our local domestic buildings have improved in comfort, we can still learn many lessons from an inspection of any of the new villa residences near the English and Scotch towns, where, for instance, you will find a bath-room, and hot and cold water laid to almost every apartment in houses having a rental of say about £100 a year (in Birkenhead I know much cheaper houses having a bath-room and water supply in two dressing-rooms); and all these trifles tending to a plentiful use of water, whether for ablutionary or flushing purposes, have a beneficial sanitary effect.

Turning to the dwellings for the middle classes, of which we have seen hundreds built on both sides of the city during the last few years, I must condemn those landlords who, purchasing waste lands, have them laid out in small holdings, let them at enormously reproductive rents, and having laid a main sewer down the proposed thoroughfare, are content to leave the roads without water-tables, and to be formed of any rubbish that may accumulate as the buildings progress, and while they insist on a house of a certain value being erected, sufficient to cover and secure their headrent, make no covenants for the exclusion of middens and large ashpits from the confined yards attached to such buildings; and when we come to look at the artisans' houses, we find the same state of things in an exaggerated form still before us in this city. I would notice what may be called the Church-road district, now under demolition for the Dublin and Drogheda Railway extension. Here there were numerous small avenues of cottages, all inhabited by workmen employed in the neighbourhood. They brought their owners large profits, and the headrents were high; the houses were badly built, there are no drains, and in only a very exceptional case is there any water laid to the dwelling; the roads were never made, and are to this day ankle-deep in mud, and impassable for any spring vehicle. I will make no further remarks on these premises, but ask you to say can habita-

tions under such conditions be healthful? I might multiply instances by describing the filth in the yards and the squalor in the dwellings I have had to visit occasionally, and where certainly the weekly tenants get bad value for their money. Much good work is being effected by the Corporation Sanitary Inspectors, and also by the constant jogging of their memories the officials now receive from the new Sanitary Association. Reform, however, in this direction must strike deep to the root of the evil, and I believe legislation should define the requirements of a tenement holding, viz.:—proper drainage, ample water supply, and the minimum cubical area requisite for the inhabitants, all which, together with the proper formation of the roads in the case of new buildings, the local authorities or special agents should have power to enforce in the same way as the late Factories Act.

Were this accomplished, our artisan and working population, alike jealous of infringement on their rights, and alive to every small act of kindness conferred upon them, would soon see that they and they alone were the gainers by the transaction, and would soon be glad to leave their present haunts for the improved accommodation, as a most nefarious system of tenement lettings at present exists, I mean in those cases where an almost pauper becomes the *person responsible to the landlord*. Here the only way of making up the rent is by the husband's uncertain earnings, and what the wife can *screw* out of the rooms, consisting of the worst accommodation, let at the highest weekly rents, and under such circumstances repairs, papering, paint, or even simple whitewash, are things unheard of, and to the localities in which they are situated *fresh* air never penetrates. It is such houses I desire to close; *this* accomplished, the philanthropic and charitable should step in and meet the demand for rooms by supplying model dwellings at a small increased rent. I know that speculations of this class have not in this town yielded a good return for the money invested, but looking back you will see that first efforts seldom succeed, it takes time to educate the public mind—for example, the tramways, which signally failed with George Francis Train, are now realities before our eyes; so with the recent increase in wages, the demand for comfortable houses has also increased among the respectable operative class.

In this country, however, each family has an ambition to occupy a separate house, so that I fear such buildings as those started by the Industrial Tenements Company in this town, or by "Peabody," in London, will not ever be popular. Cottages containing say *three* apartments, of very moderate

dimensions, built round a square, each having a scullery or wash-house attached, besides a small yard for laundry purposes, good drains, water laid on, and the heat from the kitchen or living-room fire utilized, would seem to me the most desirable class of building. In the angles of the square I would place common latrines and ash-pits, while the centre would be occupied by a general superintendent's and collector's house, and a club room for the men.

The right to inspect all the premises, at reasonable hours, should form part of the tenant's agreement, and if the services of a retired sergeant of police, or some person of that class were secured as resident superintendent, I feel confident the managers would have but little trouble, the sanitary condition of the inmates would be good, and the shareholders would have a fair interest for their outlay, as well as the satisfactory moral reflection of having done some good in that walk of life to which it hath pleased God to call them.

X.—*On Sanitary Legislation.* A Lecture by ROBERT O'BRIEN FURLONG, Esq., M.A., Barrister-at-Law.

LADIES AND GENTLEMEN,—The subject upon which I have to address you—"Sanitary Legislation"—is, I fear, by no means an attractive one. A moment's consideration, however, will suffice to convince you that it is a subject of the very highest practical importance to the sanitarian.

During the present course of lectures our attention has been directed to a variety of very interesting topics. Chemistry, meteorology, geography, medicine, and architecture, considered in their relation to the great subject of public health, have all in turn been brought under our notice; and it was considered that the series would be incomplete if it did not include a lecture on the legal aspects of the question—for experience has shown that sanitary science cannot make its way in the world without the assistance of the Legislature.

To illustrate my meaning, I may refer to one of the earlier lectures of this course, in which we were told how to discriminate between pure and adulterated foods.

Now, all the information which our friend, Dr. Reynolds, could give us on this most important subject, would not prevent our being poisoned by dishonest traders, if there were not an Act of Parliament imposing a penalty on persons selling adulterated food, and providing for the appointment of public analysts to detect adulteration.

Again—to advert to another lecture—it will not suffice to tell the public that overcrowding, will probably result in an outbreak of "typhus." The overcrowding will take place in spite of the knowledge, and the fever will probably follow. The sanitary legislator must come to Dr. Grimshaw's assistance with stringent regulations, and an efficient organization for securing their observance, and then we may expect some diminution of this form of "preventable disease."

Sanitary legislation deals with the laws and regulations for the improvement of the public health, whether in the form of Acts of Parliament, or of rules and regulations made by the various local authorities throughout the country.

It is obvious that the conditions "which science and experience inform us are necessary for the preservation of health are not to be secured without the intervention of the state."

Individuals may do their utmost to live in obedience to the natural laws of health; but in the majority of instances, they will find their efforts frustrated by the neglect of their neighbours. For one man who respects these laws multitudes live in open defiance of them.

Hence arises the *necessity* for sanitary legislation.

The *general principle* upon which it proceeds has been thus stated by Mr. Simon (the distinguished medical officer of the Local Government Board):—

> "All such states of property, and all such modes of personal action, *or inaction*, as may be of danger to the public health, must be brought within the scope of summary procedure and prevention."

The same idea is expressed by Dr. Acland* in more popular language. He says:—

> "The true principle of sanitary legislation is that the Government should help the people to do, *not* what they *can* do, but what they *cannot* do. It should strive to ascertain what hindrances there are in the way of the people's health, and to remove those they cannot remove themselves.
>
> "If the people like to live in dirty houses let them, so long as thereby they do not affect their neighbours; but let it not be impossible for them to have clean houses.
>
> "The laws should aim at securing to all whatever is *necessary* to health. Nothing is too minute for the attention of the Legislature provided the minute point is *essential*."

The subject of sanitary administration, is so closely connected with that of sanitary legislation, that I think it deserves some share of our attention; indeed a lecture on the laws relating to public health would be of very little practical use, if it did not contain some reference to the machinery provided by the state, and by the local authorities, for carrying out those laws.

My subject is so very extensive that it would be quite useless for me to attempt to treat it in anything like an exhaustive manner. I have therefore resolved to content myself with giving you a short sketch of the progress of sanitary legislation; I shall then make some general observations on the law as it stands at present and the machinery for carrying it into effect.

* Address at meeting of Social Science Association, 1872.

First, then—as to the progress of sanitary legislation :—

The first law relating to public health was passed so long ago as the year 1388.* It imposes a fine of no less a sum than £20, upon "all who cast annoyances, garbages, entrails, &c., in ditches and rivers." The mayors and bailiffs of the cities and towns were charged with the execution of this Act. It is interesting to observe that, even at this early period, the local governing bodies were intrusted with the care of the public health.

About a hundred years later we find an Act† to prohibit the slaughtering of cattle in cities, and boroughs, "lest sickness might be engendered unto the destruction of the people."

The Sanitary Commissioners (1869) tell us that the local courts were in possession of sanitary powers, and they mention an instance of the exercise of such powers, which is furnished by the Court Rolls of Stratford-on-Avon. It appears that, in 1552, Shakespeare's father was fined for depositing rubbish in the public street of that town, in violation of the bye-laws of the manor; and again, in 1557, he and five other gentlemen were "amerced in the sum of four pence each for not keeping their gutters clean."‡

Dr. Haughton called attention in his lecture, to the fact that great epidemics always produce wonderful activity about sanitary matters.

This remark applies with special force to our sanitary laws, which we owe for the most part to the panics occasioned by outbreaks of pestilence.

An attack of the plague in the reign of James I. led to the passing of an Act§ which made it a capital felony for any person suffering from the disease to go about, when commanded by the proper authority to keep his house.‖

Again, in the years 1817–19, a fearful epidemic of fever raged in Ireland, during which about a million and a half cases (of which 65,000 proved fatal) occurred, and the fever hospitals in Dublin alone treated 42,000 patients,—*i.e.* more than one-sixth of the population.¶

* 12 Richard II., cap. 13. † 4 Hen. VII., cap. 3.

Both these Acts were repealed by 19 & 20 Vic., cap. 64.

‡ The same year Mr. Shakespeare became a member of the Corporation of Stratford, and subsequently was appointed one of four "affeerors," whose duty it was to impose fines on their fellow-townsmen for offences against the bye-laws of the borough; and so he ceased to be the subject of any further prosecutions. Unlike the nuisance authorities of our time, these "affeerors," we are told, "displayed unusual vigilance, and considerable severity," in enforcing the laws.—*Collier's "Shakespeare,"* vol. i., p. lxvi.

§ 1 Jac. I., cap. 31.

‖ None of the foregoing Acts applied to Ireland.

¶ Barker & Cheyne's Hist. Sketch, vol. i., pp. 62, 94.

In 1818 a select committee of the House of Commons was appointed to report on the progress of the fever, and to suggest measures to arrest its further extension. The same year an Act was passed for Ireland,* enabling the Lord Lieutenant on the appearance of fever or other contagious distemper in any town, to appoint a Board of Health, with powers to do everything necessary for preventing the spread of contagion, and restoring the sick to health. The Board might cause the streets to be cleansed; houses, yards, &c., to be purified; beds and bedding to be disinfected, or burned; and all nuisances prejudicial to health to be removed. The funds necessary for carrying out this Act were to be advanced by the Lord Lieutenant, and repaid by presentments on the county. A penalty not exceeding £5 was imposed on persons resisting the orders of the Board, and default in payment was punishable with imprisonment for three months, without appeal.

In 1819 another select committee of the House of Commons was appointed to inquire into the state of disease in Ireland; as to the working of the Act of the previous year; and the causes of the prevalence of fever amongst the working classes. This committee, in their report, recommended the establishment of a systematic local control in all cities and towns for the removal of nuisances which generate and promote disease; and to this end they suggested the appointment of officers of health in cities and towns, to be elected by the householders, and to be armed with ample powers for the removal of nuisances, and the preservation of health. In the same year an Act was passed which embodied the principal recommendation of this committee.† Dr. Mapother‡ mentions in proof of the high estimation in which this Act was held that "An appeal that its operations should be extended to England was made by the famous Dr. Paris and Mr. Fonblanque," but without success.§

This Act provided for the annual election by the vestry of not less than two, or more than five, officers of health, in every city or town containing more than 1,000 inhabitants, or elsewhere, as the Lord Lieutenant should direct.

These officers of health were to act without salary, and the expenses incurred by them in the execution of their duties were to be levied as other parochial assessments.

The powers given to these officers, were somewhat more

* 58 Geo. III., cap. 47. † 59 Geo. III., cap. 41.

‡ Statistical and Social Inquiry Society of Ireland. Journal, vol. iv., p. 203.

§ Dr. Mapother also draws attention to the fact that the *first* Parliamentary Reports on Public Health related to Ireland, and that public attention was *first* called to the dangers of intramural sepulture, by the disgraceful state of a Dublin cemetery—Bully's-acre.

extensive than those conferred by the former Act on Boards of Health.

Both these Acts were repealed by the "Sanitary Act, 1866."*

In the year 1836 a most important step was taken in Sanitary Legislation, by the passing of an Act for the Registration of Births and Deaths, in England and Wales. This system of registration was extended to Scotland in 1854, and to Ireland not until 1864.

It seems strange that Parliament should so long have withheld from Ireland the advantages of a system which had been established in England some twenty-eight years before, and which had long been in operation among all the other nations of Europe.

The Sanitary Commissioners (1869), observe:—

"That recent sanitary legislation has been remarkably drawn out by, and connected with, three outbreaks of cholera, which led to investigations of the means of preventing infectious diseases, and so drew attention to the fact, that the seats of endemic disease are generally where the air or water is polluted."

The first visitation of cholera occurred in the year 1831, and by a temporary Act passed in the following year,† which, strange to say, was not made applicable to Ireland, the powers of the Privy Council, under the Quarantine Act, 1825,‡ were greatly extended, and the Council was enabled to issue such orders as might be deemed expedient for preventing the spread of the disease; "for the relief of persons affected thereby; or for the interment of those who fell victims to its ravages."

By an Act of the following year,§ these powers were continued until the next session of Parliament, by which time the cholera had disappeared, and the Act was accordingly allowed to expire. The possibility of a future visitation of the disease does not appear to have been contemplated by the Legislature. This is a very good sample of short-sighted and unstatesmanlike legislation.

In 1840 an Act was passed for England, Wales, and Ireland‖ which empowered Boards of Guardians and overseers to arrange for the gratuitous vaccination of all persons resident in their unions and parishes. This Act has since been repealed¶ and another substituted for it.**

* In Thom's Directory for the present year (1873), page 9, the latter of these Acts is referred to as being still in force.

† 2 and 3 Wm. IV., cap. 10.

‡ 6 Geo. IV., cap. 78. The earliest quarantine laws are to be found in an Edict of Justinian, A.D. 542.

§ 3 and 4 Wm. IV., cap. 75.

‖ 3 and 4 Vic., cap. 29. See also 4 and 5 Vic., cap. 32.

¶ By 30 and 31 Vic., cap. 84.

** 26 and 27 Vic., cap. 52.

To give some idea of the beneficial results of this legislation, I may mention, on the authority of Dr. Haughton, that the death-rate from small-pox, which before the introduction of vaccination was 66 per cent. of persons attacked, has now been reduced to 6 or 7 per cent.

In 1842 a most important series of inquiries as to the state of public health was set on foot by the English Poor Law Board. The first of the series was conducted by Mr. Chadwick, then Secretary to the Board. The results of his investigations are contained in a very valuable report, which did much to arouse public attention to the necessity for improved sanitary legislation.*

In 1843 a Royal Commission was appointed under the presidency of the Duke of Buccleuch, to investigate the causes of prevalent disease and the best means of improving the public health. This Commission made two reports.

It is much to be regretted that the admirable recommendations contained in their Second Report were not forthwith carried into effect by a comprehensive Sanitary Act.

In 1846 provision was made for the removal of nuisances and prevention of diseases, by a temporary Act,† which applied to the United Kingdom.

Two years later a law was passed, "which may be regarded as the groundwork of our sanitary legislation."

"The Public Health Act, 1848,"‡ unlike many of those to which I have already referred, was intended to be permanent. It was framed with great care, and it is of a most comprehensive character. Unfortunately it applied to England and Wales only. However, many of its provisions have since been extended to Ireland, by subsequent statutes.

This Act was of a permissive character. It was to be in force only in any locality in England or Wales, (exclusive of the metropolis) the ratepayers of which presented a petition for its application, or in which the death-rate was exceptionally high.

It provided for the appointment of a General Board of Health, to consist of three members, and to be continued for five years.

The town councils in corporate towns, and in other places, local boards, to be elected by owners and ratepayers, were constituted the local authorities for carrying out the Act.

* I have omitted all mention of the numerous Acts relating to the government of towns, which, although they contain important sanitary provisions, can scarcely be regarded as "Sanitary Acts."

† 9 and 10 Vic., cap. 96.

‡ 11 and 12 Vic., cap. 63.

In the same year the Nuisance Removal and Diseases Prevention Act of 1846, being about to expire, a similar Act was substituted for it,* and in 1849† this Act of 1848 was amended.

These two last mentioned Acts remained in force for Ireland until the year 1866, when they were repealed by the Sanitary Act of that year.

The third visitation of cholera, which occurred in 1854, led to some important changes in the sanitary laws.

The Nuisance Removal Acts of 1848 and 1849, were repealed for England, and a comprehensive Act‡ was substituted for them, which, however, did not apply to Ireland.

The powers vested in the Privy Council by the former Acts of 1846 and 1848, to make regulations for the prevention of formidable contagious diseases, were largely extended, and the provisions relating to them were embodied in a separate statute.§

In 1858 the General Board of Health, which had been created in 1848, and reconstructed in 1854, was allowed to expire, and its powers were vested in the Privy Council.

In the same year was passed the "Local Government Act, 1858,"‖ for England and Wales, which is to be construed with the "Public Health Act, 1848," as one Act. Several of its provisions have been extended to Ireland by subsequent enactments.

The new Act greatly extended local powers for the execution of sanitary works in such districts as adopted it, and gave in fact "most of the requisite powers of police and municipal government, if only they were duly sought, and duly used."

The "Nuisance Removal and Diseases Prevention Act, 1860,"¶ amended the two Acts of 1855, and amongst other things, reconstituted the Boards of Guardians as the "Local Authorities" for executing the Diseases Prevention Act.

In 1865 an Act** was passed, which applied to Ireland, enabling local authorities to dispose of the sewage of their respective districts, in order to prevent its becoming a nuisance; and to make arrangements for the application of such sewage to land, for agricultural purposes.

The local bodies were constituted "Sewer Authorities," with powers to construct sewers; to take lands compulsorily, and to prevent the pollution of streams. "This Act may be

* 11 and 12 Vic., cap. 123.
† 12 and 13 Vic., cap. 3.
‡ 18 and 19 Vic., cap. 21.
§ 18 and 19 Vic., cap. 116.
‖ 21 and 22 Vic., cap. 98.
¶ 23 and 24 Vic., cap. 77.
** 28 and 29 Vic., cap. 75.

said to have introduced into rural districts the first real instalment of active sanitary powers."

In the year 1865, the Town Council of this city presented a memorial to the Chief Secretary, calling his attention to the defective state of the sanitary laws for Ireland; and to the action then taken by that body and their distinguished medical officer of health, I believe we owe the "Sanitary Act, 1866."

The history of this Act affords a curious illustration of the hasty and unsatisfactory manner, in which our sanitary code has been formed.

At the time to which I am now referring, the cholera was supposed to be advancing towards our shores, and the special provisions of the "Diseases Prevention Act, 1855," had been put in force in England.

This Act, as I have observed, did not then apply to Ireland, and "the Nuisance Removal and Diseases Prevention Acts" of 1848–49, which are declared in the preamble to the Act of 1855, to be "defective, so far as the same relate to the prevention, or mitigation of endemic, epidemic, or contagious diseases," afforded the only protection provided for us by law, against the approach or spread of the disease.

Notwithstanding this declaration as to their inefficiency, these Acts were considered good enough for Ireland, for ten years after they had been condemned in England.

The necessity for providing an immediate remedy for this anomalous state of things, was felt so strongly by the then government, that a bill was prepared, extending to Ireland in one statute the English statutes up to 1865. However, before this bill was brought into Parliament, it was ascertained that a complete sanitary code for England was in preparation, and accordingly the Irish Bill was altered, so as to include the latest provisions of the proposed English code.*

Towards the end of the session, it was found that there was not sufficient time to allow of the English Bill being passed through Parliament. Instead, therefore, of a complete and comprehensive statute, a fragmentary and somewhat confused bill was introduced, and passed for the United Kingdom; originally intended to apply to England only, but afterwards adapted so as to suit some of the more urgent requirements of Ireland also.

However although the form of the legislation was not all that could have been desired, the benefits conferred by the Act of 1866 were large and substantial.

* Dr. Hancock's Report on the "Sanitary Act, 1866," p. xvi.

I shall notice very briefly some of its provisions.

(1.) The authorities constituted by the Act were as follows :—

- I. In cities and towns corporate—'the Corporation."*
- II. In towns and townships—the "Town"—"Township"—"Lighting and Cleansing," or "Municipal" Commissioners, as the case may be.†
- III. In such part of each union as is not under another sewer or nuisance authority—"the Poor Law Guardians."

(2.) The obsolete Nuisance Acts of 1848-49 were repealed, and the Acts of 1855, with numerous alterations, and extended powers, were substituted for them.

(3.) The vestry officers of health were abolished, and *one* nuisance authority constituted for each district.

(4.) The expenses of the nuisance authorities were charged on the borough rate in corporate towns; town rate in towns under Commissioners, and the poor rate in districts under Boards of Guardians.

(5.) All nuisance authorities were *required* to make periodic inspections of their districts, with a view to ascertain what nuisances need abatement; and were empowered to appoint and pay Nuisance Inspectors.

(6.) The definition of a nuisance was extended so as to comprise

- I. Premises in a state
- II. Any pool, ditch, or water-course so foul as to be
- III. Any animal so kept as to be
- IV. Any accumulation of matter

} injurious to health.

These nuisances were included in the Act of 1855.

The following were added to the list by the Act of 1866:—

- V. Over-crowded houses.
- VI. „ workshops.
- VII. Smoke from factory chimneys.

* The sanitary arrangements of Dublin are under the control of a Public Health Committee, consisting of about thirty members—all corporators. This committee may at any time be dissolved by the Corporation, or its members increased or diminished.

† According as the town is governed:—

1. By Commissioners under the "Towns Improvement (Ireland) Act, 1854," 17 & 18 Vic., cap. 113, or a local Act;
2. By Lighting and Cleansing Commissioners, under the 9th Geo. IV., cap. 82; or,
3. By Municipal Commissioners, under the 3 & 4 Vic., cap. 108.

(7.) Powers were given to the Privy Council *in England* to extend the quarantine law to *coasting* vessels, in case of the outbreak of contagious disease on board. These laws had previously applied to vessels coming from *foreign* ports only.

(8.) The 49th section empowers the Lord Lieutenant,* upon complaint being made that any *sewer authority* has neglected to provide sufficient sewer accommodation; or to provide a supply of water, where the existing supply is a source of danger to the inhabitants ; or that a *nuisance authority* has made default in enforcing the provisions of the Nuisance Removal Acts: to institute inquiry, and if satisfied that the authority has been in default, to limit a time for the performance of its duty in the matter of such complaint, and if the duty be not performed within the time so limited, to appoint some person to perform it,—the expenses and costs to be recovered from the local authority. Unfortunately this power is so little known that it is scarcely, if ever, exercised.

(9.) Whenever any part of Ireland *appears* to be threatened with, or affected by, any formidable epidemic, endemic, or contagious disease, the Local Government Board *may* put into force for a period of six months (which period may be subsequently extended) the provisions of the "Diseases Prevention Act, 1855," as amended by the "Nuisances Removal and Diseases Prevention Act, 1860." The Boards of Guardians are the "local authorities" for executing this special Act, and all expenses incurred under it are to be defrayed out of the poor rate. In this city, which is under the control of two Boards of Guardians—those of the North and South Dublin Unions—the Local Government Board, in the event of this Act being put in force, would probably exercise a power conferred on them by section 40, and require the two boards to act together for the purposes of the Act; or they might direct that the town council should be the "local authority" instead of the Board of Guardians. In the latter case the expenses of executing the Act would fall on the borough fund instead of the poor rates. So long as the provisions of this Act remain in force the Local Government Board may issue regulations—

1st. For the speedy interment of the dead.
2nd. For house to house visitation.

* This power has since been transferred to the Local Government Board (Ireland).

3rd. For dispensing medicines, guarding against the spread of disease, and affording to persons afflicted by, or threatened with, such epidemic, endemic, or contagious diseases, such medical aid, and such accommodation as may be required.

The "local authority" is charged with the execution of the regulations so made, and has the power of appointing medical, and other officers, and of providing everything necessary to mitigate disease. This Act was not put in force during the recent visitation of small-pox,—although it can scarcely be denied that the disease assumed the character of a "*formidable* epidemic."

Two Amendment Acts were passed in 1868 and 1869, which were originally applicable to England only, but both have since been extended to Ireland.*

The latter of these Acts enables the Commissioners of Public Works to advance money required for sanitary works executed by the Local Government Board, in case of default of the local authority, the sums so advanced to be charged on the local rates.

Another Amendment Act† was passed in 1870 for the United Kingdom, but its provisions appear to me to be inapplicable to this country.‡

"The Artisans' and Labourers' Dwellings Act, 1868,"§ supplies a want which had long been complained of by local authorities.

In any place in which this Act is in force (*i.e.* in Ireland, towns corporate, boroughs, and towns under Commissioners), on the report of the local officer of health, that any premises within his district are in a condition dangerous to health, so as to be unfit for human habitation, the local authority (*i.e.* the Corporation or Town Commissioners), shall refer the matter to a surveyor to report on the cause of the evil complained of, and the remedy therefor, and whether the premises can be improved by structural alterations, or require demolition. On receiving his report, the authority shall require the owner of the premises to execute the necessary

* 31 & 32 Vic., c. 115, and 32 & 33 Vic., c. 100, extended by Local Government (Ireland) Act, 1871.

† 33 & 34 Vic., cap. 53.

‡ The latest specimen of sanitary legislation is "The Sanitary Act, 1866 (Ireland), Amendment Act, 1873" (36 & 37 Vic., cap. 78), which provides for the payment of the expenses incurred by a Port Sanitary Authority, under the Act of 1866, sec. 30, out of a common fund to be contributed by the riparian nuisance districts, (*i.e.* districts, any portion of which abuts on any river or coast forming part of a port), in such proportions as the Local Government Board shall order.

§ 31 and 32 Vict., cap. 130.

works, and in case of default, shall order the premises to be shut up or demolished; or the authority may itself execute the works. (Secs. 5, 6, 18.) If the works be executed by the authority, such authority shall obtain from the Court of Quarter Sessions an order charging on the premises all expenses incurred, together with interest at the rate of £4 per cent. (Sec. 19.) If the owner execute the works he may obtain an order charging on the premises in which the improvements have been effected, an annuity at the rate of £6 per cent. on the amount expended—such annuity to be payable for thirty years to the owner and his representatives. (Sec. 25.)

The local authority may levy a special rate not exceeding two pence in the pound for any year, or may borrow money from the Commissioners of Public Works, to defray all expenses under the Act. (Secs. 31, 32.)

Any four or more householders living in or near to any street may represent to the officer of health that any premises in or near to that street, are unfit for human habitation, and the officer shall thereupon inspect, and report on such premises. (Sec. 12.) If the local authority neglect for three months after receiving such report to put the Act in force, the householders may address a memorial to the Local Government Board, asking for an inquiry, and upon receipt of such memorial the Board may direct the local authority to proceed under the provisions of the Act, and such direction shall be binding on the authority. (Sec. 13.)

The Act expressly provides that the absence of any representation by householders, shall not excuse the officer of health from inspecting any premises and reporting thereon. (Sec. 12.)

In 1869 a Royal Commission was appointed* to inquire into and report on the operation of the sanitary laws in England and Wales (except the metropolis), so far as these laws relate to sewerage, drainage, water supply, removal of refuse, control of buildings, prevention of overcrowding, and other means of promoting the public health; and also to inquire into and report on the operation of the laws for the prevention of contagious diseases and epidemics, and the administration of all these laws, including the constitution of authorities, and the formation of areas.

For some unaccountable reason Ireland and Scotland were

* This Commission was appointed in compliance with a request submitted in May, 1868, to Her Majesty's Ministers, by a deputation from the Social Science and British Medical Associations.

not included in the terms of the Commission. The two countries, however, were worthily represented on the Commission, by Dr. Stokes and Sir Robert Christison.

The Commissioners examined a large number of witnesses, and presented a most valuable report, the general purport of which is thus briefly summed up:—

> "The present fragmentary and confused sanitary legislation should be consolidated, and the administration of sanitary law should be made uniform, universal, and *imperative* throughout the kingdom."

Appended to the report is a summary of the existing sanitary law, together with suggestions for its amendment and consolidation.

In July, 1871, Sir C. Adderley, the Chairman of the Royal Commissioners, introduced a Bill into Parliament to consolidate and amend the laws relating to public health and local government; which was in fact the report of the Sanitary Commissioners in the form of a Bill. "The first part of the Bill proposed to repeal all existing sanitary laws, and of the 450 clauses of which it consisted, about nine-tenths were inserted, merely for the purpose of re-enactment."

The second part divided the whole country into sanitary districts, so that there should be no place without a sanitary authority, and only one such authority in each place. It was late in the session when this Bill was brought in, and it was read only a first time. So far as I am aware no attempt has been made during the present session to re-introduce it.

A very important Act was passed in the year 1871, which although not strictly a sanitary Act, so seriously affects the powers of local bodies that it deserves special mention.

"The Local Government (Ireland) Act, 1871,"* applies to towns in Ireland under any form of local government, whether the governing body consists of a Town Council, or Commissioners, under any general, or local Act.

The main object of the Act was to afford to local Boards an easy and inexpensive method of obtaining certain powers which they might desire to possess, and which until the passing of this statute could not be obtained without a special Act of Parliament,—a proceeding which, as the citizens of Dublin know too well, always entailed vast

* 34 & 35 Vict., cap. 109.

expense on the ratepayers.* Under this Act, if a local Board seek powers to acquire land for public purposes; to extend or reduce the limits of the district under their control; to transfer from the Grand Jury to the local Board their jurisdiction with regard to roads, bridges, and public works; to sanction the making of further rates in addition to the maximum authorized rates; to provide for the future execution, or repeal, or alteration of any local and personal Act in force within the town, they have only (after some preliminaries have been complied with) to present a petition to the Local Government Board (Ireland), who will thereupon direct an inquiry in respect of the matters mentioned in the petition, and if the result of the inquiry prove satisfactory, the desired powers will be conferred by a Provisional Order. This Order must be confirmed by Act of Parliament, which will not involve any expense to the parties seeking the Order.

The Bill confirming the Order may of course be opposed in its progress through either House; but in practice I think it will be found that opposition will rarely be offered.

This Act also provides for the audit by an officer of the Local Government Board, of all municipal accounts—a matter of great importance, as one of the chief objections to sanitary improvements is the increased expenditure they would entail on the already over-taxed ratepayers. Possibly it may be found that under the supervision of the Government auditor a larger portion of the public funds may be made available for sanitary purposes than is the case at present.†

"The Local Government Board (Ireland) Act, 1872," next demands our attention.‡

Its object was to concentrate in one department the supervision of the laws relating to the public health, local government, and the relief of the poor in Ireland.

* From a return lately presented to the House of Commons, it appears that a sum of £18,199 19*s.* 2*d.*, was spent by the Corporation of Dublin between the years 1864 and 1872 in promoting, watching, or opposing the progress of Bills in Parliament.

The costs of the Dublin Main Drainage Act of 1871 amounted to no less a sum than £4,290!

† The following is an extract from the report of G. W. Finlay, esq., the auditor appointed by the Local Government Board to audit the accounts of the Dublin Corporation for the year 1872:—"The amount of fines imposed under the sanitary Acts but not levied is considerable. The Corporation are entitled to these fines, and the Public Health Committee should see that the officers intrusted with the duty of levying them, discharge it with promptitude, as the non-levying is likely to have an injurious effect. It would be almost better that the Corporation should not incur the cost and trouble of legal proceedings to enforce compliance with the Acts, than, having done so, to allow the order of the magistrates to remain a dead letter by not enforcing the penalties inflicted by them."—*Report*, p. 12.

‡ 35 & 36 Vict., cap. 69.

A similar Board for England, was formed in 1871, and is now presided over by a Cabinet Minister.*

The Irish Board consists of a president, ex-officio, being the Chief Secretary to the Lord Lieutenant for the time being, a vice-president, and two other members, one of whom must be a physician or surgeon, of not less than ten years' standing.

Amongst other improvements effected by this Act I may mention the following:—

1. The Poor Law Commission was abolished, and the functions of that body vested in the new Board.

2. All powers and duties vested in or imposed on the Lord Lieutenant, the Privy Council in Ireland, or the Chief Secretary to the Lord Lieutenant, by several Acts of Parliament, including the "Sanitary Act, 1866," and the statutes amending it; the "Nuisances Removal and Diseases Prevention Acts, 1855 and 1860," and "The Sewage Utilization Act, 1865," were transferred to, and imposed upon, the new Board.

The "Public Health Act, 1872," remains to be noticed. This Act owes its existence to a feeling on the part of Her Majesty's Government, that the then session of Parliament should not be allowed to close, until *some* improvement had been effected in our system of sanitary administration.

The Bill was introduced at such a late period of the session, that it was evident that any attempt to deal with so vast a subject in a large or comprehensive manner, must of necessity be futile. There was really no time for the discussion of details, and accordingly all the clauses likely to provoke hostile criticism, and so to imperil the fate of the Bill, were dropped, and a very short, partial, and incomplete measure was hurried through both Houses of Parliament, at the very close of the session.†

The Act applies to England and Wales only; but it is pretty well understood that, if the pressure of public business permit, Parliament will be asked to sanction a similar measure for Ireland during the present session.

Time will not allow me to do more than notice very briefly, two of the leading provisions of this Act;—

1. It divides the whole of England, with the exception of

* The Right Hon. James Stansfield, M.P. The other members of the Board are the Lord President, the five principal Secretaries of State, the Lord Privy Seal, and the Chancellor of the Exchequer. The constitution of the Irish Board is preferable, as it includes three paid members, who have to devote their entire time to the duties of the Board, and one of these *must* be a medical man. The want of a medical man on the English Board is to some extent supplied by the existence of a medical sub-department under the direction of Mr. Simon, F.R.S., who was for many years the chief medical officer of the Privy Council.

† The Lords bestowed only three days on its consideration.

the metropolis, into sanitary districts. These are of two kinds—*urban* and *rural.*

The urban districts are the boroughs, Improvement Act districts, and Local Government districts; and the sanitary jurisdiction is vested in the Town Council, Improvement Act Commissioners, or Local Board, as the case may be.

Rural districts consist of such parts of the Poor Law unions, as are not included in urban districts; and the Guardians of each union form the rural sanitary authority.

The great advantage of this arrangement is, of course, that it is thoroughly exhaustive. No place in England or Wales is now without its local sanitary authority.

The Local Government Board is the central authority, and possesses the powers for sanitary purposes which formerly belonged to the Privy Council, the Home Office, the Poor Law Board, and other departments of the state.

2. By section 10, every Sanitary authority is *obliged* to appoint a medical officer of health, who in rural districts *may* be the medical officer of the union.

I have read many criticisms of this Act; and I think it is plain that it is not regarded with favour by the leading sanitarians of the sister country.

Dr. Rumsey, who is one of the first authorities in England on all matters relating to public health, while acknowledging that the promoters of the Act were actuated by an earnest desire, to propose what they believed to be best calculated to further the ultimate objects which sanitary reformers have in view, observes that—

> "There are not a few matters of grave importance, in respect of which the Act has created obstacles more or less barring future progress, and very similar to those which have so greatly complicated and enhanced the difficulties of our present legislation."

Again, the "Joint Committee on State Medicine" of the British Medical and Social Science Associations* has condemned the Act as "entirely ignoring the cardinal principles, which they consider *essential* to any well-considered reform of the laws relating to public health, and of the authorities by whom such laws should be administered."

I admit that Dr. Acland seems to regard the Act with satisfaction, and of course his opinion is of the highest authority; but even he does not consider it as in any sense a complete measure.

Lord Napier and Ettrick, the President of the Social Sci-

* This "Joint Committee" was originally appointed at the meeting of the National Association for the promotion of Social Science, held in Dublin in 1861.

ence Association,* though endeavouring to say a good word for the Act, is obliged to admit that it has no character of finality. "If," he says, "we examine the powers of administration and action committed to the sanitary authorities, we are at once involved in obscurity and confusion. The Bill has given machinery, but it has not given faculties of operation sufficiently categorical, distinct, and extensive."

I have not time to quote any other opinions, but I think I have said enough to show that *some* at least of the most eminent authorities in England regard the Act with disfavour. The leading medical journals condemn it also.

In my humble judgment it would be better, instead of accepting this Act, *mutatis mutandis*, for Ireland, to wait a little longer for a measure, or rather a series of measures—for the entire subject is too large to be dealt with in one Act—with some appearance of completeness.

No measure can be at all complete which does not supply us with a simple and intelligible body of laws, in lieu of the confused mass of statutes which at present compose our sanitary code. Everyone admits that one of the chief difficulties in the way of effective sanitary administration, is due to the large number of these statutes, and the way in which they are framed.

These statutes are of two kinds—General and Local.

In not a few instances the Local Acts contain provisions more or less at variance with the General Acts; and sometimes it happens that the ample powers of a General Act, are obliged to give place to the more limited powers conferred by the Local Act.

Besides these Local Acts, there are bye-laws without number, made under powers contained in various Acts, and which themselves have the force of law.

The Sanitary Commissioners state that *these* are sometimes in conflict with the general law of the land.

The result is that it is often very difficult, and sometimes utterly impossible, to ascertain the exact state of the law on certain points.

In Dublin we have to search for our sanitary law amongst a large variety of Local Acts, bye-laws, and regulations, besides about seventeen General Acts. How, I would ask, can the law be effectively administered when its provisions are scattered over some fifty or sixty statutes, some self-contradictory, others obsolete, and all of them vague and loosely worded?

* Inaugural address, Plymouth, 1872.

As the Sanitary Commissioners have well expressed it—

"The number of the statutes, and the way in which they have been framed, render the state of the sanitary laws unusually complex.

"This perplexity has arisen from the progressive and experimental character of modern sanitary legislation, which has led to the constant enlargement and extension of existing Acts, without any attempt at reconstruction, or any regard to arrangement. The fatal result is that the law is frequently unknown, and even when studied difficult to be understood."

Mr. Simon bears similar testimony. He says:—

"The laws which ought to be in the utmost possible degree simple, coherent, and intelligible, are often in nearly the utmost possible degree complex, disjointed, and obscure. Authorities and persons wishing to give them effect may often find almost insuperable difficulties in their way; and authorities and persons *with contrary dispositions* can scarcely fail to find excuse or impunity, for any amount of malfeasance or *evasion*."

It is much to be regretted that our legislative system provides no machinery for securing that an Act of Parliament shall be expressed in proper, and self-consistent language.

The great object of the promoters of a Bill is that it should pass; and consequently they take care that it shall be framed, not in the most logical and appropriate language, but in that which is likely to excite the least opposition. Accordingly the draftsman is often obliged to choose "the path of obscurity and confusion, to repeal merely such scraps and fragments of the existing Acts as it is absolutely necessary to get rid of; perhaps also incorporating the old Acts with the new, thereby not only making the new Act unintelligible, except by reference to the former Acts, but raising a swarm of difficulties as to its construction, and its relation to the pre-existing law." This system of incorporation is one of the greatest obstacles in the way of sanitary action.

Sanitary Law is in fact a thing of shreds and patches. An eminent medical man has described it as being made up of "little dabs of doctoring done by different departments of Government." But Government is not to bear all the blame of the present state of the Sanitary Laws. Government has not originated the host of local Acts to which I have referred. *They* have sprung up somewhat after this fashion.

* Report, p. 21.

Some active member of a local authority discovers what he considers to be a defect in the law. Perhaps his fervid imagination has suggested to him some particular form of nuisance, which might not come within the definition of a nuisance contained in the existing Acts. The evil must be met by a new Act. His colleagues are persuaded that they are utterly helpless so long as this supposed defect is allowed to continue. Accordingly a Bill is promoted in Parliament at great expense. A number of heterogeneous provisions are crammed into it; another "Improvement Act—Amendment Act"—is added to our local code, and the mess is rendered more hopeless than ever.*

Traces of this mania for special legislation are to be found in some general Acts also.

A few years ago it became notorious that people were being poisoned in large numbers by means of arsenic. Immediately an Act of Parliament was passed to control the sale of this drug alone, as if there were no other poison known.

On this principle we should have a special Act to prohibit the sale of chloroform, another of strychnine, and so on, for every poison an Act. The absurdity reached its climax in the year 1853, when one of these intelligent legislators introduced a Bill for the prevention of glanders (a disease which killed one person in the United Kingdom last year).

Again, it sometimes happens that some provisions of the Sanitary laws are at variance with the general law of the land.

A curious instance of this is afforded by what is now well known as "The Birmingham Sewage difficulty." The case was this. For some time the sewage of the town was discharged into the river Tame, in strict accordance with the provisions of the Public Health Act, 1848. At length Sir Charles Adderley obtained an injunction from the Court of Chancery, restraining the Corporation from polluting the river. The Corporation then fell back on the provisions of another Act, and turned their sewage upon the land adjoining the sewer outfall. However, the landowners in the neighbourhood very naturally objected to this proceeding, and a second injunction was obtained. Here was a dilemma! The Corporation were compelled by the Act of Parliament to receive the sewage, but the Court of Chancery refused to let them dispose of it. At length the Corporation had recourse to a Bill to enable them to utilize the sewage on some waste lands far from the town. The Bill was opposed, and

* The necessity for these Local Acts has been greatly obviated by the passing of the Local Government (Ireland) Act, 1871. See *supra*.

thrown out, and, so far as I know, "the difficulty" still remains unsolved.*

Again, the law recognises a distinction between various Sanitary duties which seems to be based upon no intelligible principle.

To quote from the Report of the Sanitary Commissioners:—

"The removal of nuisances seems to have been considered a work apart from Local Government, and the prevention of epidemic disease, a work unconnected with the suppression of its causes. Such distinctions without differences, the result of *casual legislation*, regardless of what had preceded, are far more than merely illogical or unmeaning. They cause grave misunderstanding of the law, mislead public opinion, multiply expenses, and aggravate disinclination to improvement, and distrust of science."

The distinctions between authorities are equally unmeaning.

The local bodies charged with the execution of the "Sewage Utilization Acts," and the Sanitary Act, 1866, Part 1, are designated "*Sewer* Authorities." In the Nuisance Removal Acts, the same bodies are styled "*Nuisance* Authorities," while a third title is created by the "Diseases Prevention Act, 1855," viz., "Local Authority."

In towns such as Dublin, the nuisance authority is the Town Council; but the *local* authority under the Diseases Prevention Acts is the Board of Guardians. Thus, if it should unfortunately become necessary to put these latter Acts in force in this city, the Guardians of the North and South Dublin Unions would be the "*Local* Authorities" for enforcing their provisions, while the ordinary Sanitary functions would continue to be discharged by the Corporation. We might thus have three authorities all hard at work, each trying to do the other's business, and, as a necessary consequence, neglecting its own. It is true, as I have already observed, that the Local Government Board *might* substitute the Corporation for the Boards of Guardians; but, on the other hand, they are under no obligation to do so. Dr. Hancock states that the reason why the guardians are named as the authorities under the Diseases Prevention Acts is, that they have an organization of Medical Officers and hospital accommodation, and they also control the dispensary arrangements.

Before the passing of the "Sanitary Act, 1866," there were three distinct sets of Sanitary officers in some places, viz.,

* Since this lecture was delivered I have been informed by the Town Clerk of Birmingham that the Corporation are erecting sewage works under the direction of Mr. Hawksley, C.E. In both the Chancery suits further time for the completion of the works has been obtained.

those appointed by the parish, by the town authority, and by the guardians. So things are not so bad as they used to be.

There is one matter to which I have already referred, on which all Sanitary reformers seem to be agreed, viz., that the law should be consolidated, or rather that a new and complete code should be substituted for the existing *general* Acts.

I fear that the present Government does not intend to deal with the matter, for I find that an elaborate digest of the statutes relating to *urban* Sanitary authorities in England and Wales, has just been presented to Parliament in pursuance of a promise given last spring by Mr. Stansfield, when a question was raised with respect to the consolidation of the Sanitary Laws.*

Many suggestions have been made for the amendment of the Sanitary Laws. I cannot do more than enumerate a few of the most important.

1. Many of the provisions of the Sanitary Acts which are at present permissive, should be made compulsory on the local authorities.

2. The procedure for the compulsory abatement of nuisances should be simplified.

I am told that in this city, when a magistrate's order for the abatement of a nuisance is resisted, 14 or 15 visits of inspection must be made, and about 10 different forms filled up.

3. When an owner or occupier makes default, or cannot be made amenable, the local authority itself, should be compelled to execute the necessary works.

4. The provisions of the "Diseases Prevention Acts," with certain necessary modifications should be made permanent.

5. Provision should be made for the registration of sickness.

6. The law for the registration of deaths, which is manifestly imperfect, requires amendment. It might be well to provide that no interment should take place unless on production of a certificate of registration. This is the law in England.†

* In a note prefixed to this digest, the Secretary of the Local Government Board states that "The work must not be regarded as an authoritative interpretation of the law;" and that "no attempt has been made to construe the several enactments which *appear* to be in force, or to interpret any *doubtful* or *contradictory* passages contained in them."

† Deaths are sometimes not registered for months after they occur. The deaths registered in the Dublin district during the week ending November 15, 1873, were at the rate of 35 per 1,000 of the population. In London for the same week the rate was 25 per 1,000. The excess was caused by the registration of 45 deaths which had occurred in the South Dublin Union Workhouse during the *three* preceding weeks! The death-rate in fact affords no reliable test of the health of the population. Four deaths from small-pox registered in the week ending November 22, 1873, occurred in *January*, 1872!

7. More adequate provision should be made for the payment of expenses incurred under the various Acts.

8. Compulsory powers of acquiring land for sanitary purposes should be given to the local authorities.

But although the law is confused, and in some respects defective, still I am far from thinking that the unsatisfactory sanitary condition of the country at large, is due altogether to the state of the law.

Dr. Budd of Clifton, a very eminent sanitarian, tells us that the health officer of Bristol, Mr. Davies—

"Finds that with the exception of what relates to the establishment of Fever Hospitals, the Act of 1866 gives him all the powers he could desire for preventing the spread of contagious disease." It is in the highest degree re-assuring, adds Dr. Budd, "to hear from the same practised authority, that he scarcely ever finds, on the part of the people who are the subjects of them, any difficulty in enforcing the provisions of this Act."

Dr. Burke of the Registrar-General's department gave similar testimony before the Sanitary Commissioners. He says:—

"If the Act of 1866 be thoroughly carried out, there is very little more wanted."

I think it will be found that generally speaking the blame attaches not so much to the law, as to the persons charged with its administration.

I shall endeavour to show that this is so.

There are in Ireland about 274 sanitary authorities—163 rural, and about 111 urban.

The proposed "Public Health Act" would retain them all, with power to the Local Government Board to require some of them to combine, in certain cases.

It seems a mistake to have so many authorities.

In the single county of Cork (omitting the city) there are 10 urban, and 17 rural authorities; or one to about every 17,000 of the population.

Few will be found to deny that some, at least of the urban authorities, might be got rid of with advantage.

The Vice-President of the Local Government Board, Ireland, Sir Alfred Power, K.C.B., in his evidence before the late Sanitary Commission, gives it as his opinion that—

"The sanitary functions at present *supposed* to be discharged by the authorities in small towns, should be transferred to the Boards of Guardians, and the ordinary duties of local government be left in the hands of the Town Commissioners."

The evidence of the late Dr. Hill, who for many years oc-

cupied the important position of Medical Poor Law Inspector, is to the same effect.

He says that—

"Where guardians are the local authority, the sanitary Acts have been carried out very fairly, but where a Town Council, or Town Commissioners form the authority, they do pretty nearly as they like."

Dr. Hill attributes this to the fact that—

"Town authorities are debarred from doing their duties by the expense, and there is no one to compel them to do their duty but the Lord Lieutenant, while guardians generally adopt the recommendations of the Poor Law Commissioners."

The only way in which I can form an estimate as to the manner in which our numerous urban authorities at present discharge their duties, is by observing the sums they have expended on sanitary objects. The statistics supplied by Dr. Hancock in his return of Local Taxation in Ireland for the year 1871* afford a reliable test of the action taken by these authorities. I will quote a few of Dr. Hancock's figures.

I.—As to towns under the "Towns Improvement Act, 1854." These are 75 in number.

In 43 of these towns nothing at all appears to have been spent on sanitary purposes, *i.e.*, under the "Nuisance Removal Acts," or for making drains, or sewers, or other sanitary objects.

In 17 towns the collective expenditure was under £10.

The total expenditure for the whole 75 towns was £1,567.

In Munster (exclusive of Queenstown, where about £200 were spent) the entire sanitary expenditure reached the large sum of £79; and in Connaught it was £15.

In Parsonstown, an important town, with nearly 5,000 inhabitants, the total amount charged for sanitary purposes is four shillings. I confess I am curious to know what sanitary object absorbed this sum!

II.—In 14 towns under "Lighting and Cleansing Commissioners,"† the total amount charged is £85.

III.—In 11 towns under special Acts, including 7 townships in the county Dublin, the total expenditure was £1,392.

I can see no object in maintaining a larger number of local authorities than is absolutely necessary, and it appears to me that in many instances the sanitary functions of the urban authority might with advantage be transferred to

* The latest "Return"—that for 1871—was published only in February last.

† Constituted under 9 Geo., IV., cap. 82.

the Board of Guardians of the union in which the town is situated.*

If this course were adopted in the case of towns with less than 5,000 inhabitants, the number of urban authorities would be reduced from 117 to about 44. If 10,000 were taken as the standard the number would be further reduced to 15.

So much for the towns under Commissioners.

IV.—Let us now take a glance at the state of affairs in the corporate towns. There are ten of them† exclusive of the metropolis, containing together a population of more than 409,000 inhabitants.

Here surely we might expect to find some tokens of a vigorous sanitary administration.

Nothing of the sort.

In four towns nothing at all appears to have been spent, and the total amount disbursed by the ten corporate authorities was only £2,390.

So far it is plain that the authorities I have referred to have not availed themselves very largely of their powers.

In Dublin, where there is certainly more sanitary activity than elsewhere in Ireland, the total amount expended by the Public Health Committee for 1871 was £2,050; nearly £1,000 less than was spent on the fire brigade.§

That the defects in the sanitary condition of this city are not altogether, or even in great measure due to the want of legal powers by the Corporation is, I think, very clear to anyone who will take the trouble of inquiring what powers that body already possesses.

I am happy to be able to quote in support of this view, the opinion of our present medical Officer of Health, himself an eminent sanitarian, and in everyway qualified to pronounce on such a subject:—

Dr. Mapother referring‖ to one of the numerous local Acts to which I have before alluded, "The Dublin Improvement Acts Amendment Act, 1864," observes that:—

"So ample are the provisions of this Act that it has left scarcely anything to be desired in the way of sanitary legislation, and it

* Boards of Guardians possess one great advantage as compared with urban authorities. They include, as ex-officio members, owners of property, and men of good social position, who are not dependent for their seats on the votes of the very persons whom they are sometimes obliged to prosecute for breaches of the sanitary laws.

† Viz., Drogheda, Kilkenny, Wexford, Clonmel, Cork, Limerick, Waterford, Belfast, Londonderry, and Sligo.

‡ Drogheda, Clonmel, Waterford, and Londonderry.

§ The expense of the fire brigade for 1871 was £3,082 13s. 11d.

‖ Journal of the Statistical and Social Inquiry Society of Ireland, vol. iv., p. 250.

will be the fault of the Corporation and its officers if the most substantial benefits do not soon follow. The poorer classes of the city about 100,000 in number dwell in some 8,000 houses, each room usually let as a separate tenement, and the state of these dwellings *has been* deplorable in the extreme.

"The Corporation gained by the recent Act the power to compel the owners of these houses to put in thorough repair, and keep so, the roofs, walls, and chimneys; to have their windows kept clean and glazed, and movable *at top* and bottom; to keep a properly trapped house-drain and other sanitary requisites in good order."

Dr. Mapother further expresses his belief—

"That the sanitary state of Dublin will contrast favourably with that of any other city in the United Kingdom when pure water shall be supplied to every house, when sewers are extended, and a few other improvements effected without increased taxation. A subject upon which," he adds, "our citizens are just now rather sensitive."*

I am afraid that this sensitiveness has now become chronic.

The paper from which I have quoted was written in 1865.

The Corporation did not then possess the vastly enlarged powers conferred on them by the Sanitary Act of 1866. An abundant supply of pure water has since been procured for our city; many miles of sewerage have been constructed at a cost of over £100,000; and we are paying one shilling in the pound more taxes than in 1865, and yet Dr. Mapother's predictions have scarcely been fulfilled.

The death-rate has not decreased. It was 26 per 1,000 in 1865. The epidemic of cholera in the following year raised it to 29 per 1,000.

In 1871 the rate was again 26 per 1,000, and last year another terrible epidemic† fell on us apparently with equal force, and *again* it rose to 29 per 1,000.

This death-rate is much higher than we might reasonably expect having regard to the situation of Dublin, the density of the population, and other circumstances; and, moreover, it is pretty certain that the actual death-rate is in excess of

* The Act referred to by Dr. Mapother, 27 & 28 Vict., cap. cccv., also provides (sec. 12) that when the Corporation shall have provided a slaughter-house or slaughter-houses for the use of the borough, they may purchase the licences of existing slaughter-houses, &c.

Has any use been made of this power?

† Dr. Grimshaw states that the cases of cholera, during the epidemic of 1866, within the Dublin Registration District, numbered about 2,500 with 1,186 deaths; while during the recent epidemic of small-pox there were about 12,000 or 15,000 cases, and 1,647 deaths!—*Dublin Journal of Medical Science, July*, 1873.

the rates I have quoted. All the deaths which occur are not registered. I shall mention one curious fact as affording some ground for this assertion:—

In 1871 the number of interments *in the three Dublin cemeteries* was 8,536. The total number of deaths registered in the entire Dublin Registration District for the same period was 8,144; in other words, the number of burials exceeded the number of registered deaths by 392. The excess in the previous year was 552.*

Again, in 1865 the birth-rate was 28 per 1,000, and the death-rate 26.

In 1872 the birth-rate was 27 per 1,000, and the death-rate 29.

For the same year in Glasgow, which has the reputation of being a very unhealthy city, the birth-rate exceeded the death-rate by 13 per 1,000, whereas in Dublin the death-rate exceeded the birth-rate by 2 per 1,000.†

Dr. Mapother speaks of the improvements which were to be effected in the tenement houses of the city.

My friend Mr. Henderson in his lecture last Saturday referred to the state of these houses, and regretted that there was no law to compel the owners of such houses to provide proper sanitary arrangements for them.

Let me tell you there is such a law; it is to be found in the Sanitary Act, 1866, sec. 35. I have here a copy of "Regulations for houses and parts of houses let in lodgings, *and occupied by members of more than one family,* within the borough of Dublin," issued in pursuance of the Act of Parliament by the Public Health Committee, and bearing date December 4, 1866.

These regulations provide that every person must have 300 cubic feet of air. That every tenement house must have a properly constructed ashpit and other sanitary accommodation, and these must be kept cleansed and in proper repair. The roof and walls are to be kept in *reasonable* repair and impervious to wet; the windows must open, and the yards, halls, staircases, passages, and rooms not *papered* or *oil-painted* must be lime-washed at least every six months.

There is also a regulation forbidding any person to throw

* The number of burials in the graveyards in the city of Dublin, and cemeteries in its immediate vicinity in 1860 was 8,099. The population of the city was then 254,808. It is now only 246,326, or about 8,482 less than in 1860; while the number of interments is greater by 437! The number of deaths registered in the Dublin District in 1872 was 8,973—the number of interments was 10,056—showing an excess of interments over *registered* deaths of 1,083.

† The birth-rate in London was 35, and Edinburgh 32. The death-rates wer respectively 21 and 26 per 1,000.

refuse, &c., in any street or place other than that provided for the proper deposit thereof.

What more do we want than these regulations, *if they were only enforced?*

But are they enforced? A visit to any of the poorer parts of the city will supply you with convincing proof that they are not.

You will not have very far to go in order to find specimens of these miserable tenement dwellings. They abound everywhere, in fact they form more than one-third of the total number of houses in Dublin (*i.e.*, 25,042).

I could point out to you many a locality to which Charles Dickens' description applies with perfect accuracy:—

"It is a black dilapidated street, avoided by all decent people; where the crazy houses were seized upon when their decay was far advanced, by some bold vagrants, who, after establishing their own possession, took to letting them out in lodgings. *Now*, these tumbling tenements contain by night a swarm of misery; as on the ruined human wretch vermin parasites appear, so these ruined shelters have bred a crowd of foul existence that crawls in and out of gaps in walls and boards, and coils itself to sleep in maggot numbers where the rain drips in; and comes and goes, fetching and carrying fever, and sowing more evil in its every footprint than all the fine gentlemen in office shall set right in 500 years, though born expressly to do it."*

Look in at the doorway of one of these wretched abodes. The walls are black with dirt. There is not a trace of the lime whitening enjoined by the regulations. In fact white would seem to be an impossible colour in such an atmosphere. A glance at the shattered roof will be sufficient to show that it is not "impervious to wet;" and surely that filthy passage is not the place provided "for the proper deposit of the house refuse," which covers the floor to the depth of several inches—and yet what you see from the outside indicates but very feebly the misery, moral and physical, within. How much of that misery is directly due to *our* neglect and apathy, I shall not stop to inquire. I suggest it as a subject for your reflection.

I should like to know what attempt was made to enforce these regulations in two houses (Nos. 17 and 18) in Great

* "The Sanitary Acts are only permissive, and partial in their administration. Owners of house property defy interference, and the authorities are supine. By a righteous retribution the expenses saved by non-administration of the law are consumed by surgeons' bills, extra relief, and the cost of paupers."

"Englishmen and Christian men tolerate scenes of festering corruption for both soul and body where everything tends to crush self-respect, and engender and facilitate vice."—*Archdeacon Sandford.*

Ship-street, in which my friend Dr. J. W. Moore found a population of eighty-three souls, of whom six were in fever; or in those now celebrated fever dens, No. 2, John-street, and No. 4, Mullinahack, with their population of seventeen families, and which furnished sixteen cases of fever to Cork-street Hospital within two years.

These I can assure you are not isolated instances. I sincerely wish they were.

Now, surely the law is not to blame for the state of these tenement-houses. The fault must lie with those who administer it.

Mr. Norwood, who is a valuable member of the Public Health Committee, recently stated, in a paper read before the Statistical and Social Inquiry Society, that there are in this city 9,300 tenement houses, each house containing, on the average, eleven persons.

About one-third of these houses require constant sanitary supervision, another third are not in quite so bad a state, while the remaining third only need occasional inspection.*

Now, the entire sanitary staff employed by the Public Health Committee (exclusive of the Medical Officer of Health, City Analyst, and Secretary) consist of 14 men, viz:—

2 Superintendents,
8 Sanitary Sergeants,
4 Constables,

who are all members of the Metropolitan Police Force, and are under the control of the Commissioner of Police, *as well as* of the Corporation.

How could these 14 policemen efficiently carry on the inspection of the 9,300 tenement houses, and at the same time discharge all their other sanitary duties? The thing is physically impossible.

We must not blame the officers, but the Public Health Committee, who persistently refuse to provide a sufficient number of *properly qualified* inspectors.†

In Glasgow, with a population only double that of Dublin, things are very differently managed. Here the sanitary arrangements are under the control of a Chief Medical Officer

* Mr. Norwood mentions that about 1,000 of these houses belong to three individuals!

† In a statement furnished to the Dublin Sanitary Association in February last, the Public Health Committee declare that "the duties suggested to be undertaken by the dispensary physicians, as district officers of health, are already satisfactorily discharged by eight sanitary sergeants, and two superintendents."

of Health with a competent salary; who has to devote his entire time to the duties of his post.*

Then there are district medical officers, a chief *sanitary* inspector, district *sanitary* inspectors, *nuisance* inspectors, *lodging-house* inspectors, *epidemic* inspectors, &c.

The instructions prepared for these various officers are well worth the perusal of anyone who takes an interest in the subject. I wish that our corporators could be induced to study them, as I think they might then take a higher view than they do now, of the duties and qualifications of sanitary inspectors, as distinguished from searchers for nuisances. At present the Public Health Committee seem to think that a sanitary officer must of necessity be a policeman, and they assign as a reason for not appointing additional inspectors, that the Commissioner of Police cannot spare any more members of the force!†

To take another illustration—There are rules in force in this city for the periodical removal of "manure or other refuse matter."‡

But no one pays the smallest attention to them.

I wonder how many of the citizens are aware that "all manure, or other refuse matter," must be deodorized, disinfected, and removed beyond the city boundary, from stables, slaughter-houses, and other like places every day before 7 o'clock, A.M.

The "proclamation" to which I am referring, concludes thus:—"If any of the terms of this *announcement* be disregarded, immediate proceedings will be taken against the parties in default *without further notice*: for the purpose of enforcing the penalties provided by the statute."

The penalty provided by the statute is 20*s.* a day; it is not a penalty *not exceeding* 20*s.*, but 20*s.*, neither more nor less.§

There is no clumsy procedure required here. Mr. Byrne in his edition of the Sanitary Acts observes that‖ "One notice served by the authority upon parties for the periodical removal of manure, is sufficient to call its powers into action." In my opinion the publication of the "proclama-

* The salary of the Medical Officer of Health of the Borough of Dublin is £150 per annum.

† In the statement referred to on page 30 the Public Health Committee repeat that in their opinion the duties which the Sanitary Association recommended should be intrusted to medical men, would be most efficiently discharged by policemen, owing to "their training and the facilities afforded them as constables."

‡ Notice issued by Public Health Committee under 29 & 30 Vic., cap. 90, sec. 58, Sept. 1, 1871.

§ Sanitary Act, 1866, (29 & 30 Vic., cap. 90,) sec. 58.

‖ Compendium of Irish Sanitary Law, p. 45.

tion" which I have quoted, is sufficient to render every person who does not comply with its directions liable to the penalty of £1 per diem, without any further notice.

Why do not the authorities set a good example by removing those frightful nuisances which exist in the Corporation depôts?

It is absurd to expect that the public will obey the laws which they themselves utterly disregard?

Anything better calculated to bring the laws into contempt than this practice of issuing regulations, and then not enforcing them, can scarcely be imagined.

But it is perfectly plain that these regulations could not be enforced and therefore ought never to have been made. They are impracticable. But why? Because the Corporation will not do, or at any rate has not done what the nuisance authority ought to do, before it makes such rules, render it possible for the citizens to obey them, by providing some means for the removal of manure, house refuse, &c. This has been done in Glasgow, Manchester,* Liverpool, and other towns, in which there is a proper sanitary organization, and it *must* be done in Dublin before long.

I will mention only one other instance of the way in which the health of this city is protected.

Notwithstanding the experience gained in the late epidemic of small-pox, the Public Health Committee have provided no *proper* conveyances for removing such persons suffering from infectious disorders to hospital. It is true there are some cabs attached to the hospitals and workhouses,† and there are two cabs provided by the Public Health Committee.

But cabs are not *proper* conveyances. We want *ambulances* constructed on approved scientific principles. Dr. Mapother has condemned the employment of cabs, on the ground that "the change from the recumbent, to the sitting posture, is most hurtful to the patient.‡ Indeed this is a subject upon which most medical men are agreed.

The attention of the Corporation has repeatedly been called to this defect; but they seem to consider the existing arrangements perfect.

* In Manchester the net amount spent on the removal of night soil, &c., last year was over £12,000; any private occupier can have his ashpit promptly cleansed by sending notice to the proper office. Ashpits of tenement houses, &c., are periodically emptied, and all this is done free of charge. See 2nd Report of Dublin Sanitary Association.

† Dr. Benson Baker in an article in the British Medical Journal informs us that he found only one fever cab connected with the Dublin hospitals. This was in September, 1871. On one occasion he saw a small-pox patient drawn to hospital on a greengrocer's barrow followed by a crowd of sorrowing friends.

‡ Statistical and Social Inquiry Society Journal, Vol. 2, iv., p. 207.

They certainly can plead that sanitary improvement would lead to an increase in the taxation of the city which even now is enormous; but it might be found that if economy were practised in some of the city departments, a larger proportion of the civic revenues could be made available for sanitary purposes than is the case at present.

I have dwelt at some length on the administration of the sanitary laws in this city, because I am more familiar with the working of the system in Dublin, than elsewhere. I have no wish to lead you to believe that the Public Health Committee of the Corporation of Dublin is less efficient than other similar bodies throughout Ireland. On the contrary, I dare say that in point of efficiency, the committee deserves the first place among our local authorities.

I am well aware of the enormous difficulty of the work which the committee has undertaken, and I am glad to bear my humble testimony to the valuable services it has rendered to this city. At the same time I suppose that hardly anyone will be found to contend that the sanitary condition of Dublin is what it ought to be, or what under a more vigorous administration, it might be.

Now one of the most important problems connected with sanitary legislation is—how to secure that the sanitary laws shall be administered with vigour and efficiency. Various solutions of this problem have been proposed.

An idea seems to be gaining prevalence, that local unpaid bodies, such as town councils and town commissioners, are not fit to be trusted with the care of the public health. These bodies certainly do not appear to entertain a proper sense of the responsibilities of their position. Surely if they did they would bestow a little more care upon the performance of their legitimate duties, and spend less time in discussing politics, and other matters with which they have nothing to do.

A noble Lord once remarked of a certain town council in this country, that its members seemed to think that their mission was to preserve the balance of power in Europe; to maintain the integrity of the Ottoman Porte; and to exercise a general control over the foreign and domestic policy of the government.

Now-a-days "politics are more attractive to *orators*, and more exciting to constituents, than the health and well-being of the people, which the law-givers of ancient empires made their chiefest care."

In a paper read before the Social Science Congress at Plymouth, Mr. Bulteel, a surgeon of large experience in that

place, draws a deplorable picture of the degenerate condition of these local bodies.

He says—

"Within the last twenty years, the materials of which our town councils and local boards consist have sadly deteriorated; and in many places matters have come to such a pass, that it is with the greatest difficulty a private gentleman, or a first class tradesman, can be induced to offer himself as a candidate for municipal honours, because he feels that amidst the storms, personalities, and jobberies, of local bodies, his position would be unpalatable and untenable."

Many persons think that town councils and local boards should be retained for ornamental purposes only, and that their duties and powers should be transferred to paid, and responsible officials.

I am afraid that this idea is Utopian. In the first place the public would not consent to such a revolutionary proposal.* And again, on political grounds, such a change might be unwise.

The Sanitary Commissioners (1869) observe that—

"The principle of local self-government is of the essence of our national vigour.

"Local administration, under central superintendence, is the distinguishing feature of our Government.

"The *theory* is that all that can be done, should be done by the local authority, and that public expenditure should be controlled by those who contribute to it."

Assuming then, as I think we may, that our present system of local administration must be retained, it remains for sanitary reformers to try and counteract the known evils of that system.

The public must aid the efforts of the sanitary reformers by taking more interest than they do at present in the election of the local bodies. Surely it is due to the apathy, and indifference of the respectable portion of the community, that our town councils have been allowed to become what they are. No one will pretend that the wealth and intelligence of this city are adequately represented in our Corporation. I venture to suggest to the members of the Sanitary Association, that they should try and remedy this evil by securing the return of men fitted by position and education for the discharge of the important and responsible duties, which they are called upon to perform.

* In New York the sanitary administration of the city has been taken out of the hands of the Corporation, and vested in paid commissioners nominated by the government of the state. The plan has proved successful, and is being followed in other states.

The Sanitary Commissioners have expressed themselves on this point in very clear and forcible language. They express their profound conviction—

"That no code of laws however complete in theory, can be expected to attain its object, unless men of superior education and intelligence feel it their duty to come forward to take part in its working.

"The governing bodies must possess a fair proportion of enlightened and well informed minds. A more vigorous and intelligent public opinion on sanitary matters has yet to be created in many places, and until it is created, the action of the authorities will be more or less hesitating and inconsistent. So large a discretion must be left to local authorities as to details, that in practice, much will always depend on the energy and wisdom, of those who compose such authorities.

"It seems therefore peculiarly incumbent on all who have leisure, to take their share in administering the laws. Their labours may be crowned with little honour, and will be rewarded with no emolument, but if they should hold out small temptation to ambition, there are higher motives for them in public spirit and a sense of duty.

"No institutions of voluntary benevolence are more popular, or more efficiently administered, than hospitals.

"Not only money, but time, and a large share of personal superintendence is given by their supporters; and it may fairly be asked whether to prevent disease—(at any rate to endeavour to prevent it)*—is not as worthy an object as to remove it, and whether it can be better prevented, than by giving full effect to the laws enacted for that purpose."

But it may be asked how can we secure the presence of men possessing a scientific knowledge of sanitary matters, on our local boards?

This is certainly a difficulty.

The Legislature wisely conferred a power on the various local bodies, of delegating their functions to a committee comprised *wholly* of their own members, or *partly* of their own members and *partly* of ratepayers not members of the Board.†

I do not know of a single instance in which this power of co-opting strangers has been exercised. It fully meets the difficulty I have alluded to.

I have reason to believe that in our own city the Corporation would be able to avail themselves of the learning, and great practical experience, of some of our most distinguished

* Sir W. Jenner says, "I have always taught that the highest branch of medicine is '*preventive*' medicine."

† San. Act, 1866, sec. 4.

medical men, who would be willing to make some sacrifice of their time and convenience for the public good.

But the truth is that the Corporation do not desire to be interfered with, by strangers to their own body.

They have recently excluded some of our leading citizens from the Gas Committee, on the ground that they were able to do their own business without help from outside. Possibly if they had courted the assistance of the citizens, the fate of the Gas Bill might have been different.

After this public profession of faith in their own administrative capacity, it is very improbable that the assistance of outsiders will be sought in carrying out the sanitary laws, unless, indeed, under the strong pressure of public opinion, and I fear that public opinion is not yet sufficiently enlightened, to exert such a pressure.

But the question remains, how are we to render the present system effective?

It seems to me that the remedy lies in the appointment of skilled and *specially qualified* medical officers of health, to superintend the sanitary administration within their respective districts.

Mr. Michael, a member of the English bar, who has devoted a large share of his attention to sanitary matters, emphatically asserts that—

"No system can possibly succeed which trusts for its execution to unpaid members of Boards, instead of throwing the onus both of action, and responsibility, upon competent and competently paid officials.

"A gentleman of special training, having devoted special study to hygiene, and relieved from the cares of private practice, would work incalculable good to any district which enjoyed the benefit of his services."

The Sanitary Commissioners did not consider it necessary that the health officer should be debarred from private practice; but so far as I am able to judge, the balance of opinion, at least in England, amongst persons competent to pronounce on the subject, is largely in favour of such a restriction, at least as regards "chief" officers of health.

The "Joint Committee," to which I have referred, in their report for 1871,* state that—

"Their estimate of the functions to be discharged by the medical officer of health; of his special qualifications, and of the time to be devoted to the discharge of his duties, contemplates a class of officers entirely special, and without the distractions and difficulties, which ordinary practice would necessarily entail."

* Page 9.

In an admirable pamphlet* on this subject by Mr. Ceely of Aylesbury, the author urges the necessity for having two orders of health officers—the one, engaged in practice, as union medical officers, and allowed to attend private patients; the other, debarred from general practice, receiving reports from the former, and acting over counties, or first-class boroughs.

Mr. Ceely appends three minutes of the Board of Health, which existed from 1848 to 1858, and they certainly prove that the members of the Board took a more exalted view of the province of preventive medicine, and the duties and qualifications of the health officer than now prevails.

These documents afford to my mind unanswerable reasons for the appointment of chief health officers, who shall give their time exclusively to their official duties.

The case of Liverpool may be mentioned, "where the then Home Secretary refused to sanction the admixture of private practice, with public duties, and subsequent experience has shown the soundness of that decision."

The difficulty at once suggests itself, that every sanitary authority throughout the country cannot afford to maintain officers of the stamp, I have indicated.

Various solutious of this difficulty have been proposed. Extended sanitary areas, county Boards, &c.

I fear, however, that none of the plans suggested for England, would be exactly suited to this country.

I venture to suggest the following, as a way in which the difficulty might be met.

I have already shown that the number of sanitary districts in Ireland might easily be reduced to 207—*i.e.*, 44 urban, and 163 rural.

Let each of these districts have its own medical officer, who, for obvious reasons, must be the local dispensary physician.

These officers should be allowed to pursue their private practice, and a comparatively small remuneration would compensate them for their increased duties.†

The whole country might be divided into large districts, each under the control of a chief medical officer of health,

* "Health Officers—their Appointment, Duties, and Qualifications." London: Richards, 37, Great Queen-street.

† Dr. Toler Maunsell, Honorary Secretary of the Irish Poor Law Medical Officers' Association, has just published a very useful analysis of the population, salaries of medical officers, &c., &c., of the various counties, and rural, and urban districts in Ireland, from which it appears that there are 800 dispensary medical officers. Their average salary is under £100 a year! Their salaries represent an annual poundage of ½*d.* on the valuation. The number of patients attended during the year was 741,275.

who should reside in a central part of the district, and be in constant communication with all the local officers.

This chief officer should be debarred from private practice, and should possess the special qualifications required for the post.

He should be the servant of the central authority, and be entirely independent of all local interests.

If his directions are not carried out by the local authority the default should at once be reported, and the necessary steps taken by the central authority to compel action.* Of course it would be part of his duty, to make frequent inspections of every town within his district.

The extent of the district to be allotted to each of these officers, is a matter which could easily be determined by the central authority.

It seems quite possible that the work could be efficiently carried on by eight chief officers, who might be located, say, at Enniskillen, Belfast, Dundalk, Dublin, Galway, Limerick, Waterford, and Cork.

Each district would include, on the average, about twenty unions, containing a town population of less than 190,000, and a rural population of about 490,000.

In some such way as this an efficient system of sanitary inspection and control might be carried out, sanitary action stimulated, and some beneficial results be reasonably expected to follow.

The expense of such a system would be small.

The salaries of the chief officers would range from £1,000 to £400 a year each, and need not exceed in all £5,000 a year. The State should pay these officers and their staffs. It bears half the expenses of the Poor Law medical officers' salaries, and ought not to grudge a few paltry thousands for the promotion of public health. "The result of local neglect would be national mischief, so the prevention of such a result is matter for State interference, and to be purchased, at least in part, at the State expense." The mere money cost of public ill-health owing to the loss of labour of the sick, and of those who attend them, and by increased expenditure, must be estimated at many millions a year.†

* At present the duty of reporting the neglect of the local authority rests with the public (under sec. 49 of the Sanitary Act, 1866), who seem unwilling to avail themselves of the privilege.

† The number of those who were affected by the late small-pox epidemic in this city, and who (together with their friends) were obliged to apply to the Mansion-house Relief Committee was 6,000.—*Dr. Grimshaw's Report.*

"In a money point of view few things have ever paid better than the outlay which Bristol has made, in the appointment of a Health Officer, assisted by an active staff, for the repression of disease among her citizens."—*Dr. Budd.*

But we want something more than good laws and active administration. To quote again from Mr. Michael—

"To be thoroughly successful, sanitary action must prevail within, as well as without, the dwelling. This is beyond the power of any law which a man does not enact and execute in his own house.

"The full benefit of personal action can never be experienced, until such a knowledge of sanitary science, and such a belief in its efficacy prevails, as shall constitute every man and every woman in his, or her own household, an officer of health.

"To secure such action we want a better condition of education in its practical aspects, for without this, sanitary legislation can never secure those triumphs which it is calculated to achieve."

This is true of nearly all social reforms. The masses must be taught to appreciate them. At present they are unable to understand the object of our efforts. They have been brought up in dirt, and lived in dirt, and never knew that they were anything the worse of it, and naturally enough they object to our interference with their fancied comforts. As Dr. Lankester has well observed—

"It is the ignorance of the poor, this want of knowledge of sanitary laws, a knowledge of the laws of life, the laws by which God governs the life of the community, their ignorance of the *value* of fresh air, the *value* of pure water, the *value* of warmth, the *value* of many things which they could use and employ, which causes them to die."

The only means of getting rid of this popular ignorance is education.

Let the people, rich and poor, once understand the importance of obeying the laws of health, and the difficulties of sanitary administration will be greatly reduced. The public will see the necessity for what they now regard as absurd and unnecessary regulations, and will be far more willing to conform to them.*

The common principles of sanitary science should be taught in all our schools, public and private, and then there might

* In Glasgow I find that provision is made by the authorities for the appointment of female visitors, whose duty it is to instruct the poorer classes as to cleanliness of person, cleanliness of houses, &c., and to point out how they and their children may imitate and acquire in these respects, the habits of the better classes. The visitors are cautioned not to spend time in frivolous gossip.

In the first report of the National Health Society just published it is suggested that "ladies might gather round them mothers, working women, and girls, and read or talk to them of some of the many subjects of health, and daily life, on which knowledge would be valuable; in a simple, and easy, but truthful manner."

be some chance, that the coming race would appreciate cleanliness a little more than their parents appear to do.*

At present so far from the principles of health being taught in our schools, they are generally conducted in defiance of those principles.

Mr. Edwin Chadwick, C.B., gives it as his opinion that schools are—

> "The centres of children's epidemics, and that an excess of 50,000 deaths annually in England and Wales, in the school periods of life, is due to the massing of unwashed children in ill-warmed, and ill-ventilated schools, and keeping them for hours together under these conditions."

The way to remedy this state of things is obvious. Let schools be provided with proper baths, and lavatories, and let them be properly heated, and ventilated. The pupils will then be taught habits of cleanliness, and the school will cease to be, what it too often is now-a-days, a centre of infectious disease.

In selecting a plan for a school building the sanitary arrangements should first be looked to. The architectural design is really of very secondary importance.†

The education of the adult portion of the community may be accomplished by means of lectures and classes, and by the dissemination of pamphlets on sanitary subjects.

This education must not be confined to the humbler classes of society, for I believe that a disregard of the laws of health is by no means peculiar to those classes.

There are plenty of law breakers to be found amongst the upper classes, whose mansions the sanitary inspector would not dare to visit, but where his services are often sadly needed.

* In an article on "The Science of Health" in "Good Words" for January last, Canon Kingsley advocates the establishment of public schools of health in every large town in the kingdom.

I have recently heard that a large sum of money has been given to the Birmingham and Midland Counties Institute to found a lectureship on the laws of health. The lectures are to be chiefly for the benefit of the working classes of both sexes.

† Speaking of badly ventilated schools I may observe that the Sanitary Commissioners of 1843 recommend, "that measures should be adopted for promoting a proper system of ventilation in all edifices intended for public assemblage and resort, especially these for the education of youth." It were time that this recommendation which has hitherto been completely ignored by the Legislature, should be carried into effect, for I feel sure that a vast injury to public health must result from the utter absence of proper ventilation, in nearly all our churches, court-houses, theatres, and other places of assembly.

An admirable series of sanitary tracts has been issued by the Ladies' Sanitary Association of London.

We cannot expect any very important Sanitary reforms until public opinion is strong enough to insist on them. It must be borne in mind that all social reforms are difficult of accomplishment, and we are not to be discouraged if Sanitary reform proves no exception to the rule.

As education advances and as public opinion becomes more enlightened, we may hope to see reforms effected which now appear impracticable.

It is our duty to aid in the formation of such a sound public opinion, by endeavouring to spread a practical knowledge of the laws of health among all classes of the community. The public mind needs to be aroused to a sense of the vast importance of the subject. "The public health" has been too long neglected by the legislature and by society at large; but I believe that the time is not very far distant when it must receive from both the attention which it deserves.

One of the objects of the "Sanitary Association," which has recently been established in this city, is "The creation of an educated public opinion with regard to Sanitary matters in general." I hope that before many months are past, we may have associations labouring for the same object in every large town in Ireland.*

Several organizations for promoting a knowledge of Sanitary science are at work in England, amongst which I may mention "The National Health Society," and "The Ladies' Sanitary Association." The latter of these societies has branches in various parts of England and Scotland. Voluntary organizations such as these will materially assist in educating public opinion, and so prepare the way for legislation, besides doing much to strengthen the hands of the authorities.

Some persons seem to regard Sanitary Reform as if the sole aim and object of its promoters were simply to effect some trifling reduction in our annual death-rates. A proper system of Sanitary administration would no doubt have this result, and probably to an extent which the public would scarcely be disposed to credit.

But this is not all we hope to effect. We seek not merely to rescue a few victims from the grave to which neglect would consign them, but also to deliver tens of thousands of our brothers and sisters from the physical suffering and from the moral pollution which necessarily follow from the deplorable condition of the masses throughout the country,

* Since this lecture was delivered a Sanitary Association has been formed in Cork.

chiefly amongst our town populations. As a general rule the dwellings of the poor in great towns are a disgrace to our boasted civilization. The frightful evils, physical and moral, which result from the overcrowding of large numbers of people without regard to age, or sex, in wretched, pestilential hovels are beginning to make themselves felt.

The authorities seem unable or unwilling to grapple with this difficulty, but I am glad to say that, thanks to the philanthropic efforts of a few individuals, societies have been formed in various parts of the United Kingdom, for improving the dwellings of the poor.

One of these societies, "The Artisans', Labourers' and General Dwellings Company (London)," has a capital of over £50,000, and pays its shareholders a dividend of £6 per cent. The directors state that in the houses erected by them, the average death-rate has been 6 per 1,000, while in neighbouring localities it exceeded 25 per 1,000.

"The Improved Industrial Dwellings Company" (London), has invested half a million of money, and pays a guaranteed dividend of £5 per cent. It affords accommodation to about 9,000 persons.

Some charitable persons in London have done much good by purchasing houses in poor neighbourhoods, putting them into substantial repair, and then letting them in lodgings, subject to stringent Sanitary regulations (which are enforced). This seems a more sensible plan, than that of building large mansions at great expense, and fitting them up in a costly manner—in fact, making them unsuitable for the purpose for which they were intended.

In Glasgow an enormous improvement has been effected by the Corporation, under the powers of a special Act of Parliament. Large districts have been purchased from time to time, uninhabitable houses have been demolished, and new ones erected on their sites, at a *comparatively* small cost, provided by local taxation. We want something of this sort in Dublin, where there are over a thousand houses unfit for habitation, and which require demolition. The powers conferred on the Corporation by the "Artisans' and Labourers' Dwellings Act," to which I have referred at some length, might be found sufficient for the purpose. If not, additional powers should be sought from Parliament.*

If the Corporation neglect their duty in this respect, that

* Overcrowding from want of space for building creates special diseases, and completely demoralizes the people. If I were to pitch upon one thing which is the cause of the epidemic disease, and physical and moral degradation of the population, I should say it was the system of house construction such as we have had in Glasgow for three or four generations.—*Dr. Gairdner*.

is no reason why we should neglect ours. A good example has been shown us in England, and there is no practical difficulty in the way of our following it here.

Whatever we do let us not commit the fatal mistake which I believe has done much to retard the progress of this country—that of regarding "everything as good enough, well enough, time enough."

The Sanitary movement has, as I have said, been inaugurated in Dublin. The success of that movement must depend altogether on the support, material and moral, which you, the public, afford it. I feel sure that no one who feels an interest in the well being of his race, can refuse to take part in this work.

I do not care to appeal to any of the selfish considerations which might be suggested as inducements to exertion, such as the cost of sickness, and the pecuniary saving to be effected by its prevention, or the still more frequently urged plea, that we cannot neglect the health of our neighbours without risk to the health—it may be the lives—of ourselves and our families. I prefer to rest our claims to your active sympathy, on those broad principles of Christian charity, which are common to all our creeds.

INTELLIGENCE.

SCHOOL OF ART.

DISTRIBUTION OF PRIZES.

The annual meeting for the distribution of Prizes to the Students of the School of Art was held on Friday, 19th February, in the Lecture Theatre.

His Grace the Lord Lieutenant of Ireland, *Vice-Patron* of the Society, presided.

His Grace, who was accompanied by the Duchess of Abercorn, was received by His Grace the Duke of Leinster, *President*; George Woods Maunsell, D.L., *Vice-President*; Laurence Waldron, D.L., and George Johnstone Stoney, F.R.S., *Secretaries*; the Members of the Council, the Chairman and the Members of the Committee of Fine Arts, and the Officers of the Society.

Thomas A. Jones, P.R.H.A., Chairman of the Committee of Fine Arts, addressing his Grace said, that he had the honour of bringing forward the report of the able and zealous head master on the progress of their schools during the year 1874. The report required very little introduction from him, for he was sure His Grace was well aware that art had always formed a very important part in the culture that had been bestowed on the natives of this country by this time-honoured Society. Since its formation by Dr. Samuel Madden in 1731, several most distinguished artists had received their first instruction there. They had been better known as associated with the sister island, where they had found that fame which their own shores refused, and many of the modern artists, whose works His Grace was lately kind enough to express approval of at the Royal Hibernian Academy, and some of which he had honoured with special recognition, he was proud to say, had, for the most part, received their early instructions within the walls of these schools. He might, perhaps, be excused if he narrated a personal reminiscence of one whose name was illustrious. He, himself, was introduced to the school of the Society at the age of ten by the Honorary Secretary, Mr. Isaac Weld, and the master gave him in charge to a boy older than himself, who was then finishing his course of studies. He would never forget the kindly face, dark, genial, friendly eye of that boy, who took so much interest in showing the newcomer his duty. That boy was none other than one whose loss they had recently to deplore—the late Henry Foley, the great sculptor, a native of Dublin. He (Mr. Jones) would not attempt to say one word in approval of the report, but a letter received yesterday showed in a practical manner the benefits the Society was conferring on the Art-students, and the effect produced in the sister country. The letter was directed to Mr. Lyne, by Mr. John Lewis, carpet manufacturer, of Halifax, who obtained all the gold medals at Vienna, and received the honour of knighthood from the Emperor. Mr. Jones read Mr. Lewis's letter, in which he stated—"I had much satisfac-

tion when with you in Dublin at seeing the designs executed by your Students, showing an amount of innate taste and talent highly encouraging. . . . There is no reason why designs for art manufacture could not be produced in Ireland as well as in other countries. I desire to particularize the beautiful designs I saw by Miss Ball, prepared for poplins and carpets; they showed great talent. . . . Would it be considered presumptuous in me, living at this side of the channel, to solicit you to ask His Grace the Lord Lieutenant to present to Miss Ball a real Persian rug, which I send this day to your address, as a token of encouragement, and of my interest in the welfare of the institution?"

The report from which Mr. Jones read extracts is as follows:—

To the Committee of Fine Arts.

Gentlemen,—Our Art Schools as now constituted have for their object the education of the general public in art and the improvement of design for manufactures.

The original object of the Legislature in founding Schools of *Design* was to afford instruction in that branch only.

This limited action of the schools however was found to be insufficient to enable them to carry out the object for which they were established, and the Great Exhibition of 1851, brought prominently before the public the deficiencies of the system. It was then discovered that a necessity existed of affording to the *entire community* opportunities of acquiring art knowledge of a sound kind and of giving to designers and others connected with manufacture an education and training of a much more complete kind than was at first contemplated, and in which the study of the human form should enter more or less largely.

The direct production of design for immediate practical application has not since that period been so largely insisted on in the Schools, and study with a view to æsthetic results, and unlimited by special requirements, has been more largely advocated. Such ability, when once acquired, is found to adapt itself with comparative ease to the special requirements and practical exigencies of manufacture.

The teaching resulting from the broader views I have referred to, has been attended with eminent success, and it may not be out of place here to quote the opinion of the celebrated French economist, M. Chevalier, who, in his report on the Great Exhibition of 1862, remarks:—

"The upward movement is everywhere visible—above all, among the people of the United Kingdom.

"The whole world has been struck with the progress which they have made since the last Exhibition of 1851, in designs for stuffs and in the distribution of colours, as also in carving, sculpture, and articles of furniture."

The offering of prizes by manufacturers for design, although highly encouraging, is found to be attended, if allowed too largely to influence the study of this important section of the School's work, with certain disadvantages, tending, as it does of necessity, to "tradework" imitations of prevailing fashions in design, and attempts to rival the "latest novelties." In order to comply with the requirements of manufacture, *novelty* has to be often aimed at as an end, and very often independently of those sound principles, appropriate adaptation, propriety, and good taste, which it is the special object of these Schools to inculcate, in order that one of the main objects of their establishment may be carried out, namely, the diffusion of a higher and purer taste in all ornamentation throughout the country.

Mr. Redgrave on one occasion justly remarked:—

"That it is not the object of the Schools to produce designs or patterns in the prevailing taste of the time, but in accordance with defined laws and with what is believed to be a juster taste, resulting from true principles, and quite irrespective of temporary fashions."

Thus the direct practical application of design in industrial operations I regard as a matter of secondary importance as compared with the broader action of our Schools in aiming at the diffusion amongst all ranks of Society of just ideas, right practice, and correct taste in art.

The operations of the Society's Schools thus being influenced by the broader views referred to, I beg to point out that, in accordance with such, the sections of instruction may be generally stated as follows:—

1. The study of the human form, including the life and the antique, together with anatomy and still life study.
2. Original design for manufacture, including the study of plants and botanical analysis; also the consideration and study of the best examples of ornamental art of various periods and styles, from casts and flat examples.
3. Elementary art, including practical geometry, perspective, projection along with the copying of flowers, foliage, ornaments, animal forms, and the human figure, from flat examples.

The best of those studies executed in the two first sections enter into the national competition which takes place annually in June at South Kensington, as does also the competition for the prizes of the highest or third grade.

The competition for the certificates and prizes of the second grade is a local one, and occurs generally about the end of April.

The due preparations for these various competitions occupies a very considerable portion of the school year.

The competition for medals, &c., offered by the Society, has in former years usually occurred in December, as has also the exhibition of Students' works. Such however have most seriously interfered with our classes. The inconvenience to all, consequent upon the breaking up of our Class-rooms, has led me to recommend, in the absence of special accommodation, that in future such displays, &c., should take place during the mid-summer vacation, since the more extensive operations of our Schools render it inconvenient to enter upon arrangements of such magnitude at any other season of the year. It is much to be desired, in order to prevent the disturbance of our Class-rooms for exhibitional purposes, that suitable space should be provided for the holding of exhibitions of Students' works, loans of examples of art-workmanship from the Department of Science and Art, as well as for the proper display of a permanent collection of studies of merit executed in our Schools, and such as would prove instructive and advantageous not only to our Students, but to all concerned and interested in the subject of art-teaching and its promotion throughout this country.

If, as I have suggested, special accommodation, such as I have referred to, could be provided, the month of December however would be found the most convenient season for the holding of our annual exhibition and competition.

As regards the operations of the Schools for the year that is past, it is satisfactory to me to be again able to speak of their continued prosperity, and of their eminent success in the national competition of London, one-sixteenth of the entire number of national awards competed for by

the 123 Art Schools of the United Kingdom having been won by the Society's Schools.

The position occupied by the Dublin Schools as compared with the leading schools of the most important cities and centres of industry in the United Kingdom, may be seen in the following table:—

NUMBER of NATIONAL AWARDS MADE in 1874.

Dublin,	12	Belfast,	6
Edinburgh,	11	Sheffield,	6
Manchester,	10	Glasgow,	4
Birmingham,	9	Cork,	1
Westminster,	8		

The names of those Students who have distinguished themselves by taking national awards are as follows:—

Miss E. Irwin (2 awards).	Miss F. L. Jordan.	Miss N. Lee.
Mr. E. Gibson.	Miss G. Bardon.	Miss L. M. M. O'Cleary.
Miss A. Johnston.	Miss A. Kellett (2 awards).	Miss M. Manning.
Miss E. Wallace.		

From the period of the establishment of the present national prizes in 1866, to the present time, 1,514 have been awarded by the Department of Science and Art amongst the schools of the United Kingdom, and of this number the Society's School alone has carried off the very large proportion of one-eighteenth.

Previous to the year 1866, medallions only were offered by the Department as their highest award; such medallions had the value of the present Queen's prizes.

I beg to compare the success of the Society's Schools in respect of national awards gained during the past eleven years, or for the term that I have directed the operations of these Schools, with the seven years previous to that period, the date of the establishment of such awards having been in 1857:—

National awards gained	from 1857 to 1863, inclusive,	10
Do. do.	from 1863 to 1874, inclusive,	92

Such national awards have been adjudicated to original studies in advanced stages.

The number of awards of the highest grade, known as the "third grade," for the same periods have been—

From 1852 to 1863, inclusive,	159
From 1863 to 1874, inclusive,	311

A like increase has also taken place in the less important prizes of the second class during the same period.

It is worthy of remark that the Schools have achieved their recent successes with an expenditure about half that of the period anterior to 1856. Up to that date they enjoyed the advantage of a Grant from the Government of £500 per annum.

The number of our works selected to enter the national competition amounted to fifty-four. The examiners of such works were:—Sir M. D. Wyatt; C. W. Cope, R.A.; R. Redgrave, R.A.; F. R. Pickersgill, R.A.; H. Weeks, R.A.; J. C. Horsley, R.A.; and H. A. Bowler, Esq. They consider that the school supports its high character in the good results produced in various branches, including modelling and the educational stages generally.

To those works competing for prizes of the third grade 48 were awarded to 37 Students—a greater number than has before been obtained. I may observe that South Kensington obtained 54, and Edinburgh 29 of such awards.

At the local examinations held on the evenings of the 30th April and 1st May, 154 Students were examined in one or more of the subjects of the second grade—viz., freehand drawing, practical geometry, model drawing, and linear perspective, when 77 succeeded in passing successful examinations in 109 papers, and 83 certificates, 26 prizes, and 7 full certificates were gained.

The following Students especially distinguished themselves at the examination:—

Miss S. E. Alment.	Miss L. H. Jones.	Miss H. M. Redmond.
Miss S. J. Archer.	Miss J. S. Campbell.	Miss L. M. M. O'Cleary.

The examination of those pupils of external schools in Dublin, in which drawing classes are taught through the agency of the Central Art School, took place on the 26th of May, when four small bronze medals, and eight certificates were awarded by the Society.

Great numbers of pupils continue to receive instruction in those drawing-classes in external schools of Dublin, established through the agency of this School of Art, or instructed by those who have been trained within its walls. In the absence of any exact enumeration of such I roughly estimate their number, at the present time, as about 8,000. I append to this report a list of schools having drawing-classes, and which are instructed by Mr. W. H. Murray, who has exhibited much zeal in the instruction of such classes for many years past.

The number of drawings, paintings, and models, &c., forwarded to London on the 9th day of April last, to enter into the national and other competitions, were as follows:—

Number in elementary stages,	45	works.
Do. in advanced stages,	123	,,
Ordinary class studies,	335	,,
Total	503	

The above works were executed by 239 students.

Permanent classes for the study of the living model have been established, and such students as have obtained a certificate of the second grade, and who have also gained a national award, or third grade prize for drawing or modelling the human figure from the antique or the life, will be admitted to study free in the above classes for one term.

An appointment for further free study in the life classes will be granted to those who produce studies sufficiently meritorious for competition.

Many of the original productions of the Schools continue to be utilized in manufacture, and the following have lately been produced, or are in progress, from designs of our students:—

A rich scroll carpet (Brussels), with border, by Messrs. Humphries of Kidderminster, for Messrs. Sheridan of Parliament-street, from a design by Mr. John T. Miles.

A silk-figured (amber) damask, with shamrock pattern, by Messrs. Fry and Fielding of this city, from a design by Mr. James Boyle.

A tapestry for hangings, by Messrs. Fry of Westmoreland-street, by Mr. Joseph Kavanagh.

A silk furniture damask, with black ground, and amber ornament, produced by Messrs. Fry and Fielding, from a design executed by Mr. James Boyle.

The Department of Science and Art have purchased a worked specimen of furniture damask from a design by Mr. James Boyle, and which has been produced by Messrs. Fry and Fielding of Westmoreland-street.

A carpet is now in progress of manufacture at Halifax, Yorkshire, from a design by Miss S. Ball.

A rich table damask, from a design by Miss Ball, by the Bessbrook Company.

In the late London International Exhibition a space was devoted to the display of works by Students of the Art Schools of the United Kingdom with a view to bring prominently before the public the beneficial influence of the Schools, and especially the influence they have exercised upon the productions of the country in the Department of Fine Art Manufacture. The Schools of this Society contributed a collection of works illustrative of the higher stages of art instruction, and also a selection of worked specimens executed from the original designs of our students; and I may observe that the collection furnished by the Society was remarkable, constituting, as it did, the most successul display of the productions of Art Schools; a list of such works is appended.

Mrs. Watkins has presented a set of models of portrait busts executed by her husband, the late Joseph Watkins, R.H.A.

During the past year the attendance has been as follows:—

Day students,	257
Evening students,	246
Total,	503

Of these the number of artisan students amounted to 362.

The attendance during the year shows an increase of 51 over the preceding year.

The total number of attendances amounted to 14,482; the fees amounted to £419 15*s*. 5*d*.

I may here observe that the attendance of students in our Schools compares favourably with that of the three leading Schools of South Kensington, Edinburgh, and Manchester, in which the attendance has been as follows:—South Kensington, 723; Edinburgh, 494; Manchester, 470.

My thanks are due to Miss Mary Julyan, and all those who have been associated with me in the instruction of the various classes of the Schools.

In conclusion I may remark that it is much to be regretted that many students of ability fail to continue their studies for a period sufficiently long to enable them to acquire such a knowledge of art and its processes as would, in many cases, doubtless lead to their taking ultimately high positions in the various departments of art. Profit and distinction may be obtained by everyone possessing genius, industry, and enterprise; and there has seldom been a time in any country in which the art student has had more to encourage him in his labour, and more promised in return for his ability and application. What is especially needed is a longer period devoted to the study of art, which if considered only in respect of its mechanical operations and technical processes, requires at least a period for their thorough mastery such as is usually accorded to the acquisition of a trade. It is but too common that a student becomes impatient of the intermediate steps of study, and desires,

before his time, to become an artist, and the very fact that a student of more or less ability can earn money is often fatal to the successful prosecution of study.

It is to those who patiently labour to obtain that higher development of taste and the power of generalizing nature's forms into abstractions constituting true beauty, such as is the essential spirit of art, that we must look for new and original motives in architecture, in painting, and in decoration, in short for that originality of conception in every walk of art which alone can lead to the production of work bearing the stamp of the sentiment and genius of our age, and of models worthy of study in the future.

Gentlemen, I have the honour to be your obedient servant,

R. Edwin Lyne,
Head Master and General Director.

ANALYSIS OF OCCUPATIONS OF STUDENTS.

H. M. Service, ...	9	Millwrights and Millers, . .	5
Artists and Art Teachers, . .	53	Masons, ...	3
Architects and Civil Engineers, .	13	Merchants and Traders, . .	20
Agents, &c., ...	3	Musicians, ...	1
Barristers and Attorneys, . .	8	Printers and Lithographers, .	9
Builders, ...	8	Photographers, ...	4
Brokers, ...	3	Publicans and Hotel-keepers, .	2
Carvers and Engravers, . . .	10	Stonecutters and Sculptors, .	11
Clergymen, ...	10	Iron, Brass, and Tin Workers, .	18
Cabinetmakers and Upholsterers,	15	Cooks, ...	2
Clerks and Secretaries, . . .	32	Governesses and Teachers, .	50
Chandlers, ...	3	Stationers, ...	6
Druggists, ...	4	Salesmen, ...	5
Drapers, ...	5	Saddlers and Shoemakers, . .	4
Doctors and Apothecaries, . .	10	Weavers, ...	1
Dressmakers and Tailors, . .	3	Watchmakers, ...	2
Gasfitters and Plumbers, . .	7	Other small trades, . . .	39
House Painters and Decorators, .	6	Students without any occupation,	92
Hucksters, ...	2		
Artisans in receipt of weekly wages, ...	2	Total, . . .	503

[Table.

LIST of SCHOOLS and NUMBER of PUPILS instructed during 1873–4 by WILLIAM H. MURRAY, Master for External Schools.

Name f School.	Number of Pupils. Male.	Female.	Total.
Artane Industrial, ...	146	—	146
Orphanage, Prospect, ...	108	—	108
St. Nicholas' and St. Luke's, New-street,	124	142	266
St. Audoen's, St. Michael's, St. Nicholas' (Within), Corn-market, ...	98	44	142
Ralph Macklin, Molesworth-street, . .	58	36	94
St. Patrick's Grammar School, Upper Kevin-street, ...	30	—	30
Church Education Model and Training Schools, Kildare-place, ...	148	140	288
King's Hospital, Oxmantown, . . .	70	—	70
St. Paul's Catholic Schools, North Brunswick-street, ...	210	—	210
St. James's Catholic School, Gt. James's-st.,	140	—	140
Tailors' Hall School, Wellington-quay, .	41	—	41
St. Peter's Parochial Schools, Camden-row,	100	72	172
Castleknock Morgan's Endowed, . . .	40	—	40
Mercer's Endowed, ...	—	40	40
	1,313	474	1,787

SUPPLEMENTAL SCHOOLS taught by TEACHERS trained by W. H. MURRAY.

	Male.	Female.	Total.
Claremont Deaf and Dumb, ...	30	30	60
Castleknock Parochial, ...	40	40	80
			140

EXAMINATION OF PUPILS OF DRAWING CLASSES OF SCHOOLS IN DUBLIN, 26th MAY, 1874.

MEDALS (BRONZE).

Jane Hamilton, ...	Elm Grove Seminary.
Joseph Kelly, ...	Artane Schools.
George B. Sheerin, . . .	Church Education Society
Annie Mary Jones, . . .	Pleasance Schools.

CERTIFICATES.

Emily Lunn, ...	Ralph Macklin Schools.
Elizabeth Williams, . . .	Kinder Garten Schools.
Emily Maunsell, ...	Elm Grove Academy.
A. Copeland, ...	Masonic Orphan Schools.
Kate M'Nally, ...	Masonic Orphan Schools.
Hugh Swayne, ...	St. Peter's Schools.
Henry Percy Kempston, . .	Church Education Society.
A. F. Hayes, ...	Church Education Society.
Alice Emily Brown, . . .	Church Education Society.
Patrick White, ...	Artane Schools.
W. Kennedy, ...	Artane Schools.
Michael Joseph Scallan, . .	Mount-street Schools.
Joseph Johnston, ...	Tailors' Hall School.

HIS GRACE then distributed the prizes, as particularized in the following list:—

AWARDS OF JUDGES IN THE VARIOUS COMPETITIONS OF THE YEAR 1874.

National Competition, 1874.

Awards to Students of the Royal Dublin Society's School of Art.

Names of Students.	Stage.	Description of Work.	Award.
Irwin, Miss Elizabeth, .	23 *c*	Design for Lace, . . .	Silver Medal.
Johnston, Miss Annie, .	23 *c*	Do. Muslin, . . .	Bronze do.
Gibson, Mr. Edward, .	19 *b*	Model of Figure from Antique, .	do.
Wallace, Miss Elizabeth,	23 *c*	Design for Lace, . . .	do.
Bardon, Miss G., .	23 *c*	Do. Table Damask, . .	Book (Queen's Prize)
Irwin, Miss Eliz. E., .	23 *c*	Do. Carpet, . . .	do.
Jordan, Miss Frances L.	23 *c*	Do. Lace, . . .	do.
Kellett, Miss A. M., .	10 *a*	Drawing in Outline of Foliage from Nature.	do.
Kellett, Miss A. M., .	23 *c*	Design for Wall-paper, . .	do.
Lee, Miss Nannie, .	15 *a*	Group in Water-colour, . .	do.
Manning, Miss Mary, .	23 *c*	Design for Wall-paper, . .	do.
O'Cleary, Miss L. M. M.,	23 *c*	Do. Table Damask, . .	do.

List of Students to whom Third Grade Prizes have been awarded.

Names of Students.	Prize.	Stage rewarded.	No. of Works.	Description of Work.
Birch, Miss B. . .	P 2	23*d*	2	Design for a Coffee Service. Design for an Oilcloth.
Baker, Miss L. . .	"	22*c*	2	Wall Decoration. Lace Design.
Birgin, Miss I. C. .	"	23*c*	1	Muslin Designs.
Ball, Miss S. P. .	"	23*c*	1	Original Carpet Design.
Boyle, Mr. J. T. .	"	23*c*	1	Damask Design.
Campbell, Miss I. S. .	"	23*c*	1	Design for Table Damask.
Gibson, Mr. E. . .	"	19*b*	1	Model of Figure from Antique.
Irwin, Miss E. E. .	"	15*a*	1	Still-Life Group in Oil Colors.
Irwin, Miss M. . .	"	15, 23*c*	2	Still-Life Group in Oil Colors. Lace Design.
Jordan, Miss F. L. .	"	5*b*	1	Shading from the Cast in Chalk.
Kavanagh, Mr. J. .	"	23*c*	2	Design for Limerick Point Lace. Design for Tapestry.
Kerr, Miss E. . .	"	15	1	Still-Life Group in Water Colors.
Langan, Miss L. .	"	15	1	Still-Life Group in Oil Colors.

LIST of STUDENTS to whom THIRD GRADE PRIZES have been awarded—*continued.*

Names of Students.	Prize.	Stage rewarded.	No. of Works.	Description of Work.
McSorley, Miss M. .	P 2	14*a*	1	Study of Foliage from Nature in Water Colors.
Mitchinson, Miss C. .	"	23*c*	1	Design for Surface Decoration.
M'Gee, Miss M. A. .	"	15*a*	1	Still-Life Group in Water Colors.
Martin, Miss M. .	"	5*b*, 14*a*	2	Foliage from Nature in Water. Shading from the Cast in Chalk.
Miles, Mr. J. T. .	"	8*b*², 23*c*	2	Antique Figure Shaded in Chalk. Design for Carpet.
Mercer, Mr. H. . .	"	19*b*	1	Model from the Antique (Juno.)
O'Cleary, Miss L. M. M.	"	6*a*, 5*a*	2	Outline Figure (Hercules.) Models Shaded in Chalk.
Palmer, Miss A. .	"	23*c*	1	Original Lace Designs.
Purser, Miss S. H. .	"	15	1	Still-Life Group in Oil Color.
Robie, Miss E. . .	"	14*a*	1	Study of Foliage from Nature in Water Colors.
Trevelyan, Mr. A. .	"	15, 8*b*¹, 5*a*	3	Still Life Group in Water Colors. Antique Head Shaded in Chalk. Group of Models Shaded in Chalk.
Webb, Miss M. D. .	"	17*b*	1	Head from Life (Oil Colors.)
Walker, Miss J. .	"	23*c*	1	Original Lace Design.
Bradley, Miss D. .	"	5*b*	1	Shaded Ornament from the Round.
Brown, Mr. Alexander,	P 1	4*b*	1	Ornament Shaded in Chalk.
Duncan, Miss F. .	"	4*b*	1	Ornament Shaded in Chalk.
Hanlon, Miss H. .	P 2	5*b*, 10*a*	2	Shaded Ornament. Foliage from Nature in Outline.
Jones, Miss L. H. .	P 1	4*b*	1	Ornament Shaded in Chalk.
Moore, Miss M. . .	"	4*b*	1	Ornament Shaded in Chalk.
Martin, Miss A. .	"	2*b*	1	Outline of Ornament (Tarsia.)
Manning, Miss M. .	P 2	13*a*, 10*a*	2	Flowers (Water Color) from Nature. Foliage from Nature, in Outline.
Nangle, Miss N. .	"	3*b*	1	Outline (Ornament) from the Round.
Oliver, Miss M. .	"	5*a*	1	Group of Models Shaded in Chalk.
Symes, Miss P. .	"	5*b*	1	Ornament Shaded in Chalk from the Round.

(N.B.)—P 2 signifies Highest Prize.

SECOND GRADE PRIZES.

LIST of STUDENTS who have been successful.

Name.	Nature of Examination. Free-hand.	Geometry.	Perspective.	Model.	Prize Selected.	Full Certificate.
Alment, Sarah Elizabeth, .	P	P	E	P	Instruments, . .	Certificate.
Archer, Sophia Jeanette, .	P	E	–	P	Persp.	
Barton, Rose Mary, . .	P	–	–	–		
Beardwood, F. J. . .	–	–	–	P		
Birch, Bessie, . . .	–	E	–	–	Puckett's.	
Birch, Emily Martha, .	P	–	–	–		
Bonham, James, . .	E	–	–	P	Instruments.	
Boyle, Richard B. . .	E	–	–	–	Instruments.	
Bradley, Dora, . . .	–	–	E	–	Crayons.	
Browne, Marcella J. . .	–	–	–	P		
Burke, Anna Everilda, .	–	–	E	–	Instruments.	
Campbell, Isabella Sophia,.	P	E	–	P	Persp., . . .	Certificate.
Carolin, George, . .	–	E	–	–	Stanley on Instrts.	
Churchill, Anna Forbes, .	–	P	–	–		
Copeland, Anna Matilda, .	P	–	–	–		
Crofton, Dorcas Alice, .	–	–	P	–		
D'Arcy, Louisa F. . .	–	E	P	–	Geom.	
D'Arcy, Marianne, . .	–	E	P	–	Persp.	
Davidson, Robert, . .	P	–	–	–		
Delaney, Helen, . .	P	–	–	–		
Eaton, Amy L. . . .	–	E	–	–	Persp.	
Falkiner, Anne, . . .	–	P	P	P		
Finigan, John Joseph, .	E	–	–	E	Instruments.	
Flint, John, . . .	P	–	–	–		
Fox, James Charles, . .	P	–	–	–		
Furney, Annie, . . .	–	–	P	–		
Gibson, Mary S. F. . .	P	–	–	–		
Gilligan, William H. . .	E	–	–	–	Instruments.	
Hamilton, Jane, . .	P	–	–	–		
Hallion, Edwin, . .	–	P	–	–		
Hanlon, Harriet Jane, .	–	P	–	–		
Harrison, Charles, . .	–	–	–	P		
Harrison, L. . . .	P	–	–	–		
Johnston, Annie, . .	E	–		–	Instruments.	
Jones, Annie Mary, . .	–	E	–	–	Binns' Project.	
Jones, Jeanie G. . .	–	P	–	–		
Jones, Lizzie H. . .	P	E	E	–	Colours.	

P signifies Passed, and entitles the Student to a Certificate Card. E signifies Excellent, and entitles the Student to a Prize.

LIST of STUDENTS who have been successful—*continued.*

Name.	Nature of Examination. Free-hand.	Geometry.	Perspective.	Model.	Prize Selected.	Full Certificate.
Keating, Eleanor, . .	–	–	–	P		
Kellett, Adelaide, . .	P	–	–	P		
Kennedy, George, . .	P	–	–	–		
Lawler, Patrick J. . .	P	–	–	–	—	
Lee, Nannie, . . .	–	–	P	–		Certificate.
Leybourn, John, . .	–	E	–	–	Persp.	
Long, Edward A. . .	–	–	–	E	Instruments.	
Lyne, Florence C. H. .	–	–	–	P		
M'Cormack, William, .	–	–	-	P		
MacDonnell, Annette, .	-	P	P	–		
MacDonnell, Helen, . .	–	–	P	–		
MacDonnell, Marie J. .	–	P	–	–		
M'Donnell, Mary, . .	P	–	–	–		
Macdonogh, Samuel Stuart,	P	–	–	P		
Mackenzie, Wm. Henry, .	–	E	–	–	Persp.	
Manning, May R. . .	–	P	P	–		
Martin, Anna, . . .	P	–	–	–		
Mason, Annette M. . .	–	P	–	P		
Middleton, James W. .	P	P	–	–		
Miller, George Wm. . .	P	–	–	P		
Moore, Marian, . . .	–	–	P	P		
Murphy, John, . . .	P	–	–	.		
Nangle, Nannie F. H. .	P	–	P	–	—	Certificate.
Neave, George, . . .	E	–	–	E	Colours.	
O'Clery, L. M. M. . .	P	E	P	–	Persp., ...	Certificate.
Perrin, Mary M. . .	P	E	–	–		
Redmond, Helena M. J. .	–	E	E	P	Cotman's Outlines, .	Certificate.
Riedy, Michael, . .	P	–	–	–		
Koczorowska, ——, . .	P	–	–	P		
Shaw, Alicia, . . .	P	–	–	–		
Smythe, Edith Anita, .	-	P	–	–		
Smyth, John, . . .	P	–	–	–		
Spong, William W. . .	–	–	–	P		
Toole, John, . . .	P	–	–	–		
Walker, Jeanie, . .	–	–	–	P		
Walsh, Laurence, . .	P	–	–	–		
Walshe, Harriette, . .	P	–	–	P		
White, Frances J. . .	–	P	P	–	—	Certificate.
Wilkinson, Emma J. . .	–	P	–	–		
Willson, Marian Emily, .	-	–	–	P		

P signifies Passed, and entitles the Student to a Certificate Card. E signifies Excellent, and entitles the Student to a Prize.

LIST OF DISTRIBUTION.

19TH FEBRUARY, 1875.

NAMES.	National Competition Awards.	Third Grade Awards.	Second Grade Awards.
Almant, S. E.,	—	—	Prize and Certificate.
Archer, S. J.,	—	—	Prize.
Birch, Bessie,	—	Two 1st Prizes.	Prize.
Bradley, Dora,	—	1st Prize.	Prize.
Bardon, G.,	Queen's Prize.		
Bourke, Anna E.,	—	—	Prize.
Baker, Leslie,	—	Two 1st Prizes.	
Ball, Susan P.,	—	1st Prize.	
Bergin, I. C.,	—	1st Prize.	
Campbell, Isabella S.,	—	1st Prize.	Prize and Certificate.
Duncan, F.,	—	2nd Prize.	
Darcy, L. F.,	—	—	Prize.
Darcy, Marianne,	—	—	Prize.
Eaton, Amy L.,	—	—	Prize.
Hanlon, H.,	—	Two 1st Prizes.	
Irwin, Elizabeth E.,	Silver Medal and Queen's Prize.	1st Prize.	
Johnston, Annie,	Bronze Medal,	—	Prize.
Jordan, Frances L.,	Queen's Prize,	1st Prize.	
Irwin, Marcella,	—	Two 1st Prizes.	
Jones, Annie M.,	—	—	Prize.
Jones, Lizzie H.,	—	2nd Prize.	Prize.
Kerr, Eleanor,	—	1st Prize.	
Kellett, Adelaide M.,	Two Queen's Prizes.		
Langan, L.,	—	1st Prize.	
Lee, Nannie,	Queen's Prize,	—	Certificate.
Manning, Mary,	Queen's Prize,	Two 1st Prizes.	
M'Sorly, M.,	—	1st Prize.	
Mitchinson, Caroline,	—	1st Prize.	
M'Gee, M. A.,	—	1st Prize.	
Martin, M.,	—	Two 1st Prizes.	
Moore, M.,	—	2nd Prize.	
Martin, A.,	—	2nd Prize.	
Nangle, Nannie,	—	1st Prize.	Certificate.
O'Cleary, L. M. M.,	Queen's Prize.	Two 1st Prizes.	Prize and Certificate.
Oliver, M.,	—	1st Prize.	
Palmer, A.,	—	1st Prize.	
Purser, S. H.,	—	1st Prize.	
Redmond, H. M. J.,	—	—	Prize and Certificate.
Robie, E.	—	1st Prize.	
Symes, P.,	—	1st Prize.	
Webb, Maria D.,	—	1st Prize	
Walker, J.,	—	1st Prize.	
Wallace, E.,	Bronze Medal.		
White, Frances J.,	—	—	Certificate.
Browne, Alexander,	—	2nd Prize.	
Bonham, James,	—	—	Prize,

LIST OF DISTRIBUTION—*continued.*

NAMES.	National Competition Awards.	Third Grade Prizes.	Second Grade Prizes.
Boyle, J. T.,	—	1st Prize.	
Boyle, R. B.,	—	—	Prize.
Carolin, George,	—	—	Prize.
Finigan, John J.,	—	—	Prize.
Gilligan, William H.,	—	—	Prize.
Gibson, Edward,	Bronze Medal,	1st Prize.	
Kavenagh, J.,	—	Two 1st Prizes.	
Leybourn, Rev. John,	—	—	Prize.
Long, Edward A.,	—	—	Prize.
Miles, J. T.,	—	Two 1st Prizes.	
Mercer, Henry,	—	1st Prize.	
M'Kenzie, William H.,	—	—	Prize.
Neave, George,	—	—	Prize.
Trevelyan, A.,	—	Three 1st Prizes.	

R. EDWIN LYNE, *Head Master.*

GEORGE WOODS MAUNSELL, D.L., *Vice-President*, said it now became his duty to return the thanks of the society to His Grace for attending and taking part in their proceedings that day. This was one of the noiseless triumphs of the society—it was a triumph of taste combined with industry. He trusted there might be found among the students, he addressed, some one fit to fill the place amongst artists occupied by the late Mr. Foley. The number of prizes obtained in national competition by the pupils of this school compared favourably with the results achieved in any other similar establishment. When he compared the number of pupils in this country with the number of prizes obtained he found that Dublin had carried off one prize among seven pupils, while Belfast obtained one prize among eleven; Birmingham, one among thirteen; Edinburgh, one among nine; Liverpool, one among thirty-six; Glasgow, one among twenty-two, and South Kensington, one among nine. It was gratifying to find that Dublin stood above them all, having obtained a greater number of prizes for its pupils than any other school in the Empire. The school was conducted on the principle of imparting the best and soundest technical instruction, and there had been added of late years what had been looked upon as one of the important features of such institutions, a life school for male classes. The pupils were trained from the best models placed in the best positions, and the instructions are imparted by the best certified masters. All these advantages combined to lay the foundation for a system of training which they might hope would continue to bear fruit such as that which had already given a character and name and fame to this school during the long period of its existence. In conclusion Mr. Maunsell tendered to His Grace the cordial thanks of the society for his having taken part in the proceedings of this day.

HIS GRACE THE DUKE OF ABERCORN, Lord Lieutenant, in reply, said:—Mr. Maunsell, ladies, and gentlemen, I beg to return my most sincere thanks for the kind manner in which my presence here to-day has been received. I assure you it requires no inducement to give me a strong interest in the objects of this institution and in the proceedings of the day. It is most gratifying to me to be present after an absence of six

years from this anniversary of the arts of Dublin, where, by the way, I may congratulate the muses of Ireland, whom we see around us in the persons of the fair competitors on far outnumbering the old classic regulation number of nine. It is most satisfactory to see the proofs of the advance made by Irish art students in this place. No greater proof of that could be seen than what Mr. Jones has told us as to the number of national prizes gained. It is also very satisfactory to see the great number of prizes carried away by lady students. In these days, when women's rights are much in vogue, I think there is no place where these rights could be better asserted, or received with greater cordiality by the opposite sex, than here, where so many lady competitors carry off so many prizes from others. Ladies and gentlemen, since I last had the pleasure of addressing the students in this place both art itself and the inducements to artistic life have, as has been already mentioned by Mr. Jones, received a very strong stimulus. The great increasing general wealth of England has enabled thousands, to whom art was hitherto a forbidden treasure, to gratify whatever may be their own views of artistic merit to the utmost extent of their fancy. I do not say that this has altogether been an unmixed benefit, for I think indiscriminate wealth has very often encouraged indiscriminate art; the price paid has not always been the test of real merit; but I think the encouragement has had this great advantage—that real artistic merit is certain in the end to assert itself; and if it does not receive at once the advantage of momentary profit, it is sure at least to secure future success and honour. Let me explain my meaning. I think that owing to the encouragement given by the overrich, perhaps not overskilled public, a tendency has arisen in a popular school of English art to run into a mannered realism; that is, an idea has arisen that exact and accurate, and perhaps exaggerated copying of nature—of the fibres of leaves, the hues and texture of bark, the tesselated foliage of plants, and the gaudy colours of flowers, or even the cold or literal transcript of landscape—an idea has arisen that this is high art, and this realism has been carried into what I may call, for want of another term, *tableaux de genre*, and also into sacred subjects, and we find the literal figure of ordinary everyday men and women substituted for the halo of poetic ideality with which such subjects had been formerly treated by great masters. This may be profitable art, but it is not high art. But don't imagine for a moment that I wish to advise my hearers not to cultivate profitable art. The idea I wish to convey is that there is something in the long run higher and more æsthetic than that profitable art. I would say to art students, study nature in all her forms, in the varied hues with which she colours the marvels of her vegetable world; study the anatomy of the human frame and the lights and shadows with which nature irradiates her landscape; but when you have done all this; when you produce the exact *fac simile* of the leaf, the vivid likeness of the flower, the correct copy of the human form—don't imagine you have attained high art. You have only attained the alphabet of art from which—to take a simile from the alphabet of letters—must be evolved the higher expressions of idea and design which constitute artistic merit of the highest order. I would therefore say to art students, persevere to the utmost of your power in the study of nature, and in careful practice in the school of design of everything appertaining to nature as affecting art, for without that your artistic genius would be of no avail. But I ask you to remember that this is but the means to an end, and that you should look upon it as a means which will enable you to give that utterance to the higher conception of art, which alone will

make you true artists. I shall illustrate my meaning by reference to a work which created a great sensation, and which, no doubt, has been viewed with extreme interest by the lady students. I mean Miss Thompson's picture of the "Roll Call." In that work you will see that there is a very great degree of realistic power displayed in the representation of the minute and accurate detail of a military company; but instead of being a merely realistic cluster of soldiers the genius of the artist has invested the whole group with a highly artistic conception. Every soldier in the picture has his own individual history, and a whole world of pathos and interest is opened up in almost every figure. This is the point to which I wish to draw your attention—not to confine yourself to the copying, or even the imitating of the best exemplars otherwise than as a means to enable you to carry out the higher conception of art. Ladies and gentlemen, to the few observations I have ventured to make upon what is a phase of modern British art, I may add that I think it is a proof of the highly artistic character inherent in the Irish nation that the ideal and imaginative are more natural to them than mechanical realism, and therefore that a judicious union between the two might be most successfully cultivated. There is no doubt that Irish students who have only had art training in Ireland have not altogether the advantage of the models and exemplars which others have enjoyed, and to which they have opportunities of more easy access. But, taking this into consideration, we have every reason to be gratified with the progress made in this institution, and the great advance in art that was observable in the Royal Hibernian Academy Exhibition, which I had the pleasure of visiting on Monday last. That exhibition is a proof of the great success art training has had in Ireland. I will not detain you further than to say that if any means can be found for the advancement of art, or if any way can be devised by which art culture can be extended in Ireland, I shall always be found most anxious and willing to afford all the assistance that lies in my power.

The proceedings then terminated.

APPENDIX.

METEOROLOGICAL JOURNAL,

KEPT AT

The Royal Dublin Society's Botanic Garden, Glasnevin,

FROM

1ST AUGUST TO 30TH DECEMBER, 1874.

AUGUST, 1874.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Saturday, .	29·940	66	29·921	64·2	61·0	67·1	55·0	57·6	60·1	106·8	48·9	S.W.	·010	Breezy, cloudy, light showers.
2 Sunday, .	29·720	67	29·701	66·0	65·8	68·1	62·2	59·0	61·0	115·0	58·4	S.W.	·000	Breezy, cloudy, occasional sun.
3 Monday, .	30·016	66	29·995	65·8	65·4	67·0	49·0	57·6	60·0	129·0	44·0	S.W.	·000	Do.
4 Tuesday, .	29·722	60	29·721	58·8	57·0	61·0	51·3	56·0	58·2	93·8	48·0	S.W.	·430	Breezy, showery, cloudy.
5 Wednesday,.	29·524	64	29·512	62·9	62·9	63·0	49·2	55·2	57·4	93·0	40·0	S.W.	·140	Do.
6 Thursday, .	29·950	65	29·936	64·0	63·8	60·0	48·0	55·2	58·1	105·4	43·0	S.W.	·000	Breezy, cloudy, occasional sun.
7 Friday, .	29·600	69	29·576	68·0	67·8	69·2	59·8	58·0	59·6	125·0	56·0	S.W.	·000	Do.
8 Saturday, .	29·616	65	29·602	67·0	66·8	68·3	57·0	56·1	59·0	128·2	46·3	S.W.	·000	Do.
9 Sunday, .	29·732	64	29·720	63·0	59·0	65·2	49·8	55·4	57·6	124·0	44·6	S.W.	·010	Cloudy, light showers, occasional sun.
10 Monday, .	29·430	65	29·418	64·3	60·0	65·9	64·0	56·1	58·2	105·8	50·0	S.W.	·240	Cloudy, heavy showers, occasional sun.
11 Tuesday, .	29·638	64	29·624	67·1	60·2	67·4	51·0	54·8	57·1	123·0	47·0	S.W.	·050	Stormy, showery, bright sun.
12 Wednesday,.	29·664	63	29·678	61·4	54·2	62·0	46·0	52·8	55·6	111·0	41·0	S.W.	·120	Do.
13 Thursday, .	29·300	62	29·295	60·6	57·2	64·0	53·8	54·8	57·9	96·2	51·6	S.W.	·130	Cloudy, mild, showery. [and lightning.
14 Friday, .	29·650	63	29·644	61·8	57·4	62·0	51·0	53·8	56·0	100·8	48·1	S.W.	1·620	Breezy, heavy rain, occasional sun, thunder
15 Saturday, .	29·850	61	29·849	59·0	55·2	60·0	50·4	53·0	56·0	109·0	48·0	S.W.	·020	Breezy, light showers, occasional sun.
16 Sunday, .	29·972	63	29·966	61·4	55·9	62·8	50·0	54·3	56·5	95·8	48·6	S.W.	·000	Breezy, cloudy, occasional sun.
17 Monday, .	30·192	64	30·179	62·1	55·9	64·2	49·0	54·0	56·3	101·0	43·9	S.W.	·000	Do.
18 Tuesday, .	30·288	70	30·257	68·3	64·5	69·8	54·9	56·2	58·0	101·5	52·0	S.W.	·000	Do.
19 Wednesday,.	30·382	76	30·334	75·6	67·6	75·0	50·2	59·1	60·2	111·0	45·0	S.E.	·000	Fine, mild, bright sunshine.
20 Thursday, .	30·478	78	30·424	77·3	69·8	77·9	53·2	61·0	61 ·9	114·8	48·4	S.E.	·000	Do.
21 Friday, .	30·556	73	30·517	72·1	65·9	72·8	53·9	61·8	62·4	119·5	48·2	S.E.	·000	Do.
22 Saturday, .	30·506	76	30·456	74·6	67·4	75·6	55·1	62·8	63·6	117·6	48·6	S.E.	·000	Do.
23 Sunday, .	30·450	75	30·408	73·9	65·8	76·2	50·2	62·0	63·4	121·0	45·0	S.E.	·000	Fine, mild, bright sun.
24 Monday, .	30·256	69	30·230	67·8	62·6	68·0	51·0	61·6	63·1	107·0	47·8	S.E.	·390	Foggy, mild, occasional sun.
25 Tuesday, .	30·132	67	30·111	65·1	60·8	66·2	56·0	60·0	62·1	98·4	53·9	S.E.	·000	Cloudy, showery, occasional sun.
26 Wednesday,.	30·052	73	30·015	71·0	64·0	71·9	53·0	60·1	61·8	127·4	47·9	S.W.	·070	Fine, mild, bright sun.
27 Thursday, .	29·682	57	29·690	56·0	54·2	57·4	53·2	57·9	60·2	74·8	48·0	S.W.	·090	Breezy, showery, changeable.
28 Friday, .	29·816	68	29·792	65·8	59·8	67·9	45·0	56·0	58·9	123·0	39·0	S.W.	·230	Breezy, cloudy, occasional sun.
29 Saturday, .	29·670	65	29·656	64·1	56·0	69·4	48·9	55·1	58·0	121·0	44·0	S.W.	·200	Do.
30 Sunday, .	29·660	60	29·659	58·1	56·2	59·4	49·6	54·0	56·2	109·2	42·0	S.E.	·470	Breezy, showery, occasional sun.
31 Monday, .	29·610	62	29·604	60·6	57·9	63·0	52·0	55·1	57·1	107·0	48·0	S.E.	·020	Breezy, light showers, occasional sun.
													4·240	

SEPTEMBER, 1874.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Tuesday,	29·510	67	29·491	65·9	60·9	68·4	56·0	57·1	59·0	129·0	50·4	S.W.	·110	Fine, breezy, bright sun.
2 Wednesday,	29·650	67	29·631	66·0	59·0	68·0	53·5	56·1	58·6	121·0	45·8	S.W.	·020	Breezy, showery, bright sun.
3 Thursday,	29·754	67	29·735	66·2	57·9	67·8	51·0	55·4	57·9	127·8	43·4	S.W.	·010	Do.
4 Friday,	29·834	62	29·828	60·5	54·0	61·4	50·9	54·6	57·8	107·9	44·2	S.W.	·030	Do.
5 Saturday,	30·008	60	30·000	58·2	52·9	61·0	46·2	53·1	56·0	92·4	40·9	S.W.	·220	Do.
6 Sunday,	29·812	61	29·811	58·6	52·4	61·2	52·3	58·0	60·9	101·0	48·9	S.W.	·000	Cloudy, showery, occasional sun.
7 Monday,	29·952	62	29·946	61·8	57·2	62·4	53·9	55·0	56·8	112·0	49·8	S.W.	·000	Breezy, cloudy, occasional sun.
8 Tuesday,	29·854	64	29·842	62·8	56·3	63·0	49·2	54·8	57·1	101·0	44·6	S.W.	·120	Do.
9 Wednesday,	29·400	61	29·400	58·9	52·8	60·3	46·1	53·2	57·0	118·0	38·4	S.W.	·140	Breezy, showery, occasional sun.
10 Thursday,	29·430	58	29·435	55·9	53·2	56·9	47·1	51·0	54·2	115·9	42·0	S.W.	·210	Do.
11 Friday,	29·474	61	29·474	59·9	57·9	61·8	49·0	51·3	53·8	113·0	43·0	S.W.	·060	Breezy, cloudy, showery, changeable.
12 Saturday,	29·846	64	29·834	62·4	58·8	62·9	46·6	52·4	55·0	101·9	41·9	S.W.	·000	Fine, breezy, bright sunshine.
13 Sunday,	30·280	62	30·272	61·2	54·9	62·4	45·9	52·0	54·6	117·0	40·4	N.E.	·000	Cloudy, mild, occasional sun.
14 Monday,	30·200	66	30·179	65·4	56·9	66·3	39·0	51·9	54·2	106·0	34·0	S.W.	·000	Fine, breezy, bright sun.
15 Tuesday,	29·950	64	29·938	62·9	60·4	64·2	57·0	54·0	55·9	115·0	52·0	S.W.	·000	Breezy, cloudy, changeable.
16 Wednesday,	30·050	62	30·041	61·8	54·1	62·4	50·0	53·6	55·8	118·0	44·0	N.E.	·000	Cloudy, mild, occasional sun.
17 Thursday,	29·954	61	29·953	59·2	56·4	59·8	41·0	51·0	54·2	110·0	34·9	S.W.	·000	Fine, breezy, bright sun.
18 Friday,	29·970	61	29·967	59·0	53·0	61·4	51·9	51·6	54·0	117·0	48·0	S.W.	·000	Cloudy, mild, occasional sun.
19 Saturday,	29·864	62	29·873	60·4	56·8	61·9	48·6	52·1	54·3	92·8	43·4	S.W.	·000	Breezy, cloudy, changeable.
20 Sunday,	29·720	66	29·700	65·6	58·1	66·4	56·0	53·8	55·1	83·0	48·0	S.W.	·000	Cloudy, mild, occasional sun.
21 Monday,	29·482	62	29·477	60·6	58·4	61·6	53·0	53·2	55·0	104·8	44·9	S.E.	·530	Cloudy, mild, changeable.
22 Tuesday,	29·440	62	29·435	61·9	55·2	61·8	52·4	53·0	54·9	109·5	43·9	S.E.	·050	Stormy, heavy showers, occasional sun.
23 Wednesday,	29·950	68	29·926	66·9	60·4	67·0	52·0	53·6	55·4	115·8	46·9	S.W.	·000	Fine, breezy, bright sun.
24 Thursday,	30·150	68	30·124	66·8	59·1	68·6	44·6	53·2	55·8	123·6	39·1	S.W.	·000	Do.
25 Friday,	30·162	72	30·125	70·8	63·9	71·2	53·0	55·8	56·9	118·9	46·4	S.W.	·000	Do.
26 Saturday,	30·172	61	30·169	59·8	57·1	60·0	55·1	55·2	57·9	116·0	50·0	S.W.	·000	Cloudy, mild, changeable.
27 Sunday,	29·940	62	29·934	60·2	58·9	61·2	55·0	54·6	56·9	79·4	49·2	S.W.	·000	Do.
28 Monday,	29·530	64	29·518	62·4	56·9	63·4	53·6	55·8	57·0	106·4	47·4	S.W.	·270	Breezy, cloudy occasional.
29 Tuesday,	29·322	56	29·333	54·9	53·6	56·2	47·4	53·0	55·2	76·4	42·8	S.E.	·000	Cloudy, showery occasional.
30 Wednesday,	29·666	62	29·660	61·1	52·2	61·2	43·0	51·2	53·6	111·6	35·3	S.W.	·000	Fine, breezy, bright sun.
													1·820	

OCTOBER, 1874.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Thursday, .	29·546	58	29·550	55·8	51·4	56·7	36·4	49·1	52·1	110·4	30·2	N.W.	·020	Fine, breezy, bright sun.
2 Friday, .	29·162	51	29·189	50·2	46·9	52·8	49·2	48·9	51·4	110·0	40·8	S.W.	·040	Breezy, showery occasional.
3 Saturday, .	29·334	54	29·351	52·1	48·9	54·3	43·0	47·0	50·2	96·8	37·8	S.W.	·000	Do.
4 Sunday, .	29·512	56	29·521	54·9	47·9	55·0	40·1	47·0	49·4	109·9	35·2	N.W.	·000	Breezy, cloudy, occasional sun.
5 Monday, .	29·954	54	29·970	52·8	47·9	55·4	38·0	45·2	48·2	108·0	34·1	S.W.	·060	Do.
6 Tuesday, .	29·386	58	29·391	56·3	54·6	57·2	43·4	47·6	49·2	109·0	34·8	S.W.	·340	Breezy, showery, changeable.
7 Wednesday, .	29·322	53	29·344	51·8	48·9	52·8	46·2	47·0	50·2	100·0	41·2	S.W.	·000	Breezy, showery, occasional sun.
8 Thursday, .	29·842	58	29·846	55·8	49·4	55·4	32·7	45·6	48·9	101·0	28·0	S.E.	·030	Fine, breezy, bright sun.
9 Friday, .	29·750	61	29·747	60·5	52·8	60·6	48·2	47·0	50·0	112·4	41·9	S.W.	·160	Breezy, cloudy, occasional sun.
10 Saturday, .	29·860	59	29·864	57·1	53·1	57·6	51·2	49·8	51·2	119·0	42·0	S.W.	·000	Breezy, showery, occasional sun. [sun.
11 Sunday, .	29·950	55	29·965	53·0	51·4	54·2	45·6	49·1	50·6	106·2	48·9	S.W.	·050	Breezy, showery, changeable, occasional
12 Monday, .	29·956	60	29·955	58·9	55·2	59·4	52·9	50·1	51·6	84·9	42·0	S.W.	·020	Breezy, light showers, changeable.
13 Tuesday, .	29·978	55	29·993	53·8	49·2	54·4	50·2	50·2	51·6	74·0	47·9	S.E.	·000	Breezy, cloudy, changeable. [sional sun.
14 Wednesday, .	29·572	62	29·566	60·8	55·6	61·2	46·1	50·1	52·0	94·6	39·2	S.E.	·400	Breezy, cloudy, heavy showers, occa-
15 Thursday, .	29·206	58	29·211	55·8	54·8	57·2	52·0	50·4	51·8	113·0	47·4	S.E.	·360	Cloudy, wet, changeable.
16 Friday, .	29·764	59	29·768	57·9	51·8	57·9	41·2	49·0	51·3	107·5	32·4	S.W.	·070	Fine, mild, light showers, bright sun.
17 Saturday, .	29·572	63	29·566	61·8	55·9	62·0	48·0	50·1	51·8	105·2	38·9	S.W.	·030	Breezy, showery, occasional sun.
18 Sunday, .	29·726	61	29·725	59·2	56·4	61·0	49·2	50·0	51·4	94·8	40·2	S.W.	·030	Do.
19 Monday, .	29·844	54	29·859	52·9	48·8	53·6	45·0	48·6	51·0	111·0	38·9	N.W.	·020	Do.
20 Tuesday, .	30·080	55	30·095	53·0	50·4	54·2	40·4	46·2	48·0	97·0	34·5	S.W.	·140	Do.
21 Wednesday, .	29·630	49	29·656	47·9	43·2	48·4	47·4	47·1	49·2	96·4	42·5	S.W.	·020	Stormy, showery, occasional sun.
22 Thursday, .	29·784	50	29·810	49·8	46·0	50·4	42·4	45·4	48·0	104·2	36·2	N.W.	·000	Breezy, cloudy, occasional sun.
23 Friday, .	30·076	49	30·110	47·9	45·4	48·4	35·1	42·8	46·2	76·0	30·5	N.W.	·000	Cloudy, cold, changeable. [sun.
24 Saturday, .	29·876	56	29·885	55·1	51·8	55·8	44·2	45·2	47·1	70·6	39·8	S.E.	·190	Cloudy, mild, changeable, occasional
25 Sunday, .	29·784	57	29·793	56·0	51·8	58·6	49·2	48·2	49·8	89·4	46·4	S.W.	·080	Breezy, showery, occasional sun.
26 Monday, .	29·888	54	29·904	53·2	52·4	55·0	37·2	46·2	48·4	100·0	31·9	S.E.	·050	Cloudy, showery, changeable.
27 Tuesday, .	29·978	59	29·983	56·8	53·0	58·6	50·4	49·5	50·2	103·2	44·1	N.W.	·000	Cloudy, mild, occasional sun.
28 Wednesday, .	30·046	54	30·061	52·0	49·6	53·2	43·8	47·4	49·6	69·4	37·2	N.E.	·440	Cloudy, cold, heavy showers.
29 Thursday, .	30·186	52	30·206	51·0	44·0	52·0	44·2	46·3	48·2	66·5	42·0	N.E.	·030	Cloudy, mild, light showers.
30 Friday, .	30·392	54	30·407	52·1	44·6	52·8	49·0	47·8	49·6	71·0	45·1	N.E.	·000	Cloudy, mild, changeable.
31 Saturday, .	30·356	52	30·376	50·6	47·4	53·2	43·2	47·2	49·1	67·2	53·1	S.E.	·000	Breezy, cloudy, changeable.
													2·580	

NOVEMBER, 1874.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers 5 Inch.	Earth Thermometers 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Sunday, .	30·180	55	30·194	54·2	51·6	54·8	48·0	47·1	49·2	82·6	44·2	S.E.	·240	Breezy, cloudy, occasional sun.
2 Monday, .	29·874	57	29·883	55·1	53·9	55·6	42·8	47·8	49·4	79·1	37·0	S.E.	·030	Breezy, showery, occasional sun.
3 Tuesday, .	30·014	54	30·029	52·0	48·6	53·0	34·9	46·4	48·9	77·0	30·6	S.W.	·000	Breezy, cloudy, occasional sun.
4 Wednesday, .	30·030	61	30·027	59·1	57·9	59·4	52·0	48·8	50·1	85·6	45·9	S.W.	·000	Fine, mild, bright sun.
5 Thursday, .	30·004	51	30·029	49·2	48·6	50·8	50·2	48·0	49·6	94·0	42·4	S.W.	·160	Cloudy, showery, changeable.
6 Friday, .	30·256	56	30·264	55·0	49·8	55·2	34·8	47·4	48·6	92·4	30·9	S.W.	·000	Fine, breezy, bright sun.
7 Saturday, .	30·400	57	30·409	55·2	49·8	55·6	42·0	45·4	47·6	96·2	31·6	S.W.	·000	Do.
8 Sunday, .	30·364	53	30·384	52·1	51·0	52·9	38·4	44·6	46·2	84·9	30·4	S.E.	·030	Cloudy, light showers.
9 Monday, .	30·280	61	30·277	60·2	57·1	60·5	51·4	48·0	49·2	90·4	44·8	S.W.	·000	Fine, breezy, bright sun.
10 Tuesday, .	30·282	50	30·307	48·0	44·1	49·0	40·6	46·0	49·0	93·0	34·0	S.W.	·000	Do.
11 Wednesday, .	30·200	44	30·243	42·9	40·6	43·8	31·9	41·9	44·6	86·4	27·2	N.W.	·020	Breezy, cold, occasional sun.
12 Thursday, .	30·228	44	30·271	42·1	39·2	42·9	28·6	39·0	42·8	87·0	24·8	N.W.	·000	Breezy, hail showers, occasional sun.
13 Friday, .	30·076	50	30·110	48·2	45·0	49·2	38·0	40·8	42·0	83·4	32·0	N.W.	·020	Breezy, cloudy, occasional sun.
14 Saturday, .	30·250	49	30·275	48·1	45·1	49·4	37·0	41·2	42·9	66·8	31·0	S.W.	·010	Breezy, cloudy, light showers.
15 Sunday, .	29·922	50	29·948	47·2	46·9	50·1	46·8	43·0	44·6	57·9	42·4	S.W.	·150	Breezy, wet, changeable.
16 Monday, .	29·728	50	29·754	48·9	47·8	50·0	47·9	43·2	45·0	69·4	37·6	S.W.	·190	Breezy, heavy showers, occasional sun.
17 Tuesday, .	29·940	50	29·966	48·6	43·2	49·2	48·2	45·2	46·6	97·4	46·4	N.W.	·110	Breezy, cloudy, showery.
18 Wednesday, .	29·808	56	29·817	55·1	53·8	55·8	48·9	47·6	48·2	71·0	46·6	S.W.	·140	Do.
19 Thursday, .	29·748	50	29·774	48·9	46·0	49·2	44·0	45·2	47·6	80·4	41·0	S.W.	·000	Breezy, cloudy, occasional sun.
20 Friday, .	30·040	48	30·071	46·8	43·4	47·0	30·0	42·6	45·4	82·6	29·8	N.W.	·000	Fine, breezy, bright sun.
21 Saturday, .	30·046	49	30·071	47·2	44·8	48·0	34·2	41·8	44·2	81·2	30·0	S.E.	·030	Cloudy, cold, changeable.
22 Sunday, .	29·850	50	29·876	48·4	44·0	49·0	45·6	43·0	44·8	63·2	42·0	S.E.	·020	Breezy, cloudy, showery.
23 Monday, .	30·060	49	30·091	47·2	45·8	48·0	46·3	43·2	45·0	73·2	44·0	S.E.	·010	Cloudy, light showers, changeable.
24 Tuesday, .	29·946	52	29·967	50·9	48·0	51·0	45·2	44·0	45·6	72·0	40·2	S.E.	·470	Cloudy, mild, changeable.
25 Wednesday, .	29·592	54	29·618	52·6	49·6	54·1	49·2	45·2	46·8	74·8	42·9	S.W.	·140	Cloudy, wet, changeable.
26 Thursday, .	29·690	48	29·720	47·2	46·0	47·6	35·2	43·4	45·4	72·6	30·2	S.W.	·220	Cloudy, showery, occasional sun.
27 Friday, .	29·488	58	29·519	46·4	45·0	47·8	36·0	42·3	44·6	72·8	30·1	S.W.	·000	Breezy, cloudy, occasional sun.
28 Saturday, .	29·300	57	29·337	45·8	45·2	46·8	35·2	42·0	44·0	77·6	30·3	S.E.	·940	Breezy, cloudy, showery.
29 Sunday, .	29·764	45	28·807	43·6	42·4	43·0	42·0	41·3	43·4	52·0	39·6	S.W.	·000	Breezy, cold, changeable.
30 Monday, .	28·926	47	28·965	46·8	44·0	46·4	30·9	40·0	43·0	85·4	24·8	S.W.	·160	Fine, breezy, bright sun.
													3·090	

DECEMBER, 1874.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometers.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Tuesday, .	29·568	46	29·605	45·2	42·0	46·2	35·0	39·8	42·0	94·0	29·6	S.W.	·000	Fine, bright sun, showery.
2 Wednesday, .	30·006	39	30·042	37·9	35·0	39·0	29·4	36·4	40·0	87·3	24·6	S.W.	·000	Fine and bright, sharp frost.
3 Thursday, .	30·020	44	30·063	42·1	40·9	43·4	28·2	35·8	38·2	88 0	21·6	S.W.	·000	Breezy, cloudy, occasional sun.
4 Friday, .	29·870	48	29·901	47·4	45·3	47·8	30·9	36·8	37·6	73·4	26·2	S.W.	·050	Breezy, showery, occasional sun.
5 Saturday, .	29 654	50	29·680	48·5	45·6	49·0	43·2	41·0	42·0	81·2	33·1	S.W.	·740	Fine, breezy, bright sun.
6 Sunday, .	29·362	41	29·417	39·8	37·8	42·3	38·0	39·4	41·6	78·0	36·4	S.W.	·080	Breezy, wet, changeable.
7 Monday, .	29·930	42	29·979	41·8	38·8	41·9	33·2	37·6	40·8	76·6	28·7	S.W.	·200	Breezy, snow showers, occasional sun.
8 Tuesday, .	28·988	55	29·005	53·8	51·6	54·6	36·4	39·8	40·6	89·4	29·4	S.W.	·410	Breezy, showery, occasional sun.
9 Wednesday, .	29·496	40	29·551	38·1	36·8	38·9	33·9	38 0	40·4	82·0	29·2	S.W.	·000	Cloudy, heavy rain, occasional sun.
10 Thursday, .	29·676	38	29·709	35·4	34·8	35·8	29·8	35·6	38·7	72·0	25·9	N.W.	·160	Cloudy, occasional sun, sharp frost.
11 Friday, .	28·520	42	28·571	41·9	40·2	42·0	34·9	37·0	39·0	70·4	31·9	N.W.	·030	Breezy, showery, occasional sun.
12 Saturday, .	29·312	44	29·357	41·0	40·0	41·8	38·0	38·0	39·8	65·0	33·8	N.E.	·000	Fine, breezy, bright sun.
13 Sunday, .	29·728	40	29·783	38·4	36·2	38·2	30·1	35·2	37·4	70·0	25·8	N.E.	·000	Breezy, bright sun, sharp frost.
14 Monday, .	30·138	40	30·192	39·8	37·6	39·2	29·6	34·0	36·9	85·6	23·8	N.W.	·080	Do.
15 Tuesday, .	29·806	36	29·873	35·2	32·6	40·2	31·2	33·6	35·1	72·3	24·3	S.E.	·140	Cloudy, light frost, snow showers.
16 Wednesday, .	29·860	39	29·920	37·8	34·6	37·9	31·4	33·4	36·0	54·0	25·8	N.E.	·050	Do.
17 Thursday, .	30·322	39	30·381	36·5	34·4	38·0	30·0	33·2	35·4	75·0	24·0	N.E.	·000	Breezy, bright sun, snow showers.
18 Friday, .	29·986	40	30·041	38·4	37·2	39·0	25·4	32·0	34·8	82·0	22·6	S.W.	·040	Breezy, cloudy, sharp frost.
19 Saturday, .	29·980	43	30·029	41·2	39·6	41·6	36·2	35·0	36·2	75·9	30·8	S.W.	·000	Fine, breezy, bright sun.
20 Sunday, .	29·696	40	29·751	39·1	37·4	39·8	33·4	34·0	36·0	70·0	27·4	N.W.	·000	Breezy, cold, changeable.
21 Monday, .	29·606	40	29·661	39·1	37·0	39·8	31·8	34·0	35·4	80·0	25·8	N.W.	·000	Fine, breezy, bright sun.
22 Tuesday, .	30·714	41	29·769	40·2	36·6	40·8	26·8	33·2	35·6	93·0	21·8	S.E.	·000	Do.
23 Wednesday, .	29·790	40	29·845	37·6	36·2	38·2	26·2	32·0	34·5	84·0	21·4	S.E.	·000	Cloudy, cold, changeable.
24 Thursday, .	29·574	44	29·618	42·4	40·0	42·8	37·2	35·0	36·2	77·6	33·5	N.W.	·000	Breezy, showery, bright sun.
25 Friday, .	29·758	35	29·830	33·4	33·0	36·1	30·4	33·0	35·4	72·4	24·9	N.W.	·000	Cloudy, sharp frost, occasional sun.
26 Saturday, .	30·000	40	30·054	38·0	36·9	38·4	29·8	33·1	35·6	76·2	23·9	N.W.	·000	Do.
27 Sunday, .	30·218	36	30·283	34·6	32·4	35·2	26·2	32·0	34·1	70·4	21·0	N.W.	·080	Do.
28 Monday, .	30·200	38	30·259	36·2	35·4	37·0	32·0	32·0	34·3	68·0	26·7	W.	·150	Cloudy, showery, changeable.
29 Tuesday, .	30·028	38	30·087	36·2	36·0	37·0	32·4	33·0	34·6	60·0	29·0	S.E.	·780	Do.
30 Wednesday, .	30·190	35	30·255	34·0	32·4	34·6	33·1	33·0	34·8	55·2	27·0	S.E.	·000	Breezy, heavy rain, snow showers.
31 Thursday, .	30·092	38	30·151	36·0	32·4	36·5	27·9	32·0	34·0	54·4	21·4	S.E.	·090	Breezy, occasional sun, snow showers.
													3·420	

95

Vol. VII.

No. XLV.—Vol. VII.] [Price 3s.

THE JOURNAL

OF THE

ROYAL DUBLIN SOCIETY.

CONTENTS.

DUBLIN:

HODGES, FOSTER, AND CO., 104, GRAFTON-STREET,

BOOKSELLERS TO THE ROYAL DUBLIN SOCIETY.

LONDON: SIMPKIN, MARSHALL, AND CO. EDINBURGH: JOHN MENZIES AND CO.

1878.

Dublin: Printed by Alexander Thom, 87 & 88, Abbey-street, for Her Majesty's Stationery Office.

The Society

Royal Dublin Society,

LEINSTER HOUSE.

FOUNDED 1731. INCORPORATED 1749.

THE Society consists of Members, who, on being proposed and seconded, are elected at the next Meeting by Ballot, previously to which the Fees, as follows, must be lodged with the Treasurer:—

Life Membership, ...	£21 0 0
Annual Membership (with £3 3s. Entrance Fee), .	2 2 0

Annual Subscriptions due on 1st January. Persons in arrear on the 1st April cease to be Members.

Annual Members may at any time become Life Members upon payment of £15 15s., £10 10s., or £5 5s., according to standing.

I.—MEETINGS OF THE SOCIETY AND THE COUNCIL.

1. *Stated and Ordinary Meetings.*

The Society meets at 3 o'clock, P.M., pursuant to the Charter, on the second Thursday in November, and the first Thursday in March and June.

The Council meets during the Session at Three o'clock on every Thursday not occupied by the Meetings of the Society.

2. *Evening Scientific Meetings.*

Meetings of the Society, for the reading and discussion of Papers on Scientific subjects, are held on the third Monday in each Month during the Session.

Persons desirous to read Communications must submit their Papers to the Committee a week, at least, previously, for examination and approval.

The Copyright of all Papers read becomes the property of the Society; and such as are considered suitable for the purpose will be published in the Scientific Proceedings or Transactions of the Society.

Except under special circumstances, no person can be permitted to occupy the Meeting in reading a Paper for a longer period than half-an-hour; and the Society will not be held responsible for any opinions advocated in the communications read.

Each Subscriber of 5s. to the Refreshment Fund is entitled to Tickets, to admit Visitors, at 6d. each; or to twelve for 5s., available for any of the ordinary Meetings throughout the Session.

THE STANDING COMMITTEES.

The following Standing Committees, with relation to the Scientific branch of the Society, are annually elected, as follows:—1. The Physical and Experimental Sciences; 2. The Natural Sciences; 3. Science applied to the useful Arts and Industries.

The Conversation and Reading-rooms, which are provided with Newspapers and a large collection of Periodicals, are open daily.

The Conversation and Reading Room, which is provided with a large collection of Periodicals, including Newspapers, and in which all the recently purchased Works remain for one Month, is set apart for the exclusive use of the Members.

THE JOURNAL

OF THE

ROYAL DUBLIN SOCIETY.

XI.—*On the Constitution of Benzol.*

By CHICHESTER A. BELL, M.B., UNIV. DUB.

Read Monday Evening, March 1st, 1875.

AMONGST the many curious and remarkable facts which the labours of modern chemists have brought to light, the existence of isomerism undoubtedly occupies the foremost place. That there should be found in nature, or formed artificially, a number of substances which, while having the same ultimate chemical composition, present nevertheless different, in many cases directly opposite properties, is a fact sufficiently striking in itself, but which gains much in interest when we attempt to explain on what these differences depend. The older development of the atomic theory which regarded the various characters of a compound as dependent solely on the nature and relative proportions of its constituent elements, is found to be no longer sufficient, and chemists, although able in some cases by a reference to analytic or synthetic reactions to assign a cause, if not the prime cause, for these phenomena, in others have been compelled to abandon the region of pure experiment, and plunge more or less into that of speculation. And principally to this discovery of isomerism is, I think, to be attributed the more scientific direction which chemical inquiry has taken of recent years, and also its comparatively limited range. For the chemistry of the present day no longer corresponds strictly to the old definition that it is "that science which treats of the nature and properties of all bodies simple or compound," but might more accurately be described as that study whose object is to ascertain the ultimate affections of the particles of elementary matter to which its properties in the aggregate are due.

That the solution of this latter problem should at some time become the grand object of chemical investigations, is, of course, most natural; but yet I think it is not too much to say that by the discovery of isomerism, chemists have been, in a measure,

forced to attempt it. And here I would be understood to speak of isomerism in its most restricted sense, namely, as applied to those bodies which possess not only the same ultimate composition, but also chemical characters varying only in degree and not in kind, which form precisely similar combinations, and decompose into exactly the same products. This application of the term isomer excludes on the one hand the extensive classes of polymers and metamers, and on the other substances which must be regarded as simply allotropic modifications of one and the same; even in this sense of the word the examples of isomers are sufficiently numerous.

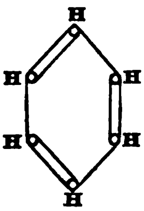
Inasmuch, then, as the decomposition products of these isomers are the same, the explanation of the differences between them is obviously not to be sought in any division into distinct groups of the elementary atoms which compose their molecules, but must be looked for in some more minute constitutional variations; and although chemists are still far from having furnished a general solution of this interesting question, I hope to show that a theory has been devised which furnishes a rational explanation of isomerism, and one completely in accordance with the results of experiment, in that class of compounds in which it is, at first sight, most difficult to account for it, namely, in the derivatives of benzol included under the term "aromatic series." I say it is more difficult to account for the isomerism observable in benzol derivatives, than for the same phenomenon as met with in the fatty series; because, by no means as yet known to chemists is it possible to resolve benzol into two or more simpler compounds, without utterly destroying its molecule. This very stability, the fact that only under exceptional circumstances does it combine directly with other substances, the non-existence of lower homologues to it, and above all the isomerism so common amongst its derivatives, have long since pointed it out as a body endowed with a peculiar constitution, and made it an object of attention and close study on the part of chemists; and as the results of recent investigations on it are of the highest theoretical importance, and likely, moreover, to exercise considerable influence on the chemistry of the future, I have thought them a fit subject to bring before the members of this Society. To the chemist they *must* of necessity be important as touching the groundworks of his study, and to those less acquainted with science it may yet prove interesting to learn some of the means and methods of reasoning, by which chemists hope to penetrate the mysteries which surround the constitution of matter.

Time would not permit of my tracing the various steps by which our views regarding this remarkable compound have been developed. I shall, therefore, content myself with giving a brief account of those views, as now almost universally accepted by chemists, giving only those arguments in support of them which appear to me to carry conviction, and for the proper under-

standing of which a knowledge of chemical minutiæ is not essential.

The very ingenious theory of M. Kekulé, propounded some years ago, all the more ingenious because, at that time, the data on which it rested were comparatively scanty, was founded on the following experimental facts:—1st. The formula $C_6 H_6$ for benzol. 2nd. The fact that it acts as a saturated body, having no free affinities, and therefore yielding in general only substitution compounds; and 3rd. The known tetratomicity of carbon. From these premises M. Kekulé concludes that the molecule of benzol is formed by a closed chain of six carbon atoms, each of which is connected by two affinities to one of its neighbours, and by one to the other, the remaining free affinity being saturated by a hydrogen atom, as in the annexed diagram, in which the small circles represent the carbon atoms.

FIG. 1.



It will be observed that the construction of the benzol molecule is here supposed to be perfectly symmetrical, and that all the hydrogen atoms are similarly situated with respect to it; but that the relative positions of any one hydrogen atom, and of the three which follow it in the same direction, are different.

Thus we have the principal peculiarities of benzol accounted for: For 1st, as it has no free affinities, it does not combine directly with other substances; 2nd, each of the hydrogen atoms being connected with a different carbon atom, we have a plausible explanation of the fact that no two of them are replaceable by a single atom of a diatomic element; and 3rd, this representation shows that if new molecules be successively formed by the substitution of a single atom of any given element or radical for each atom of hydrogen in the benzol nucleus, the resulting compounds must be identical; but that 4th, when two or more are replaced at the same time, isomers are possible, inasmuch as the *relative* positions of the substituting groups may vary.

Such then is M. Kekulé's benzol theory—a theory whose application has been fruitful in practical results, the true test of its value—and the extension of which to other classes of compounds, promises still more in the future. We shall now see how the deductions from it agree with the results of experiment.

The ground for the assumption of the equivalency, as regards position, of the six atoms of hydrogen, was found in the fact that the compounds resulting from the replacement of a single atom of hydrogen by one of a monatomic element or radical, from whatever source prepared, were invariably identical. Thus only one Chlorbenzol, $C_6 H_5 Cl$, one Brombenzol, $C_6 H_5 Br$, one Nitrobenzol, $C_6 H_5 (N O_2)$, one Phenol, $C_6 H_5 (O H)$, one Aniline, $C_6 H_5 (N H_2)$, &c., were known. Now, although from these facts the equivalency of the six atoms of hydrogen might be legitimately inferred, it will be observed that the proofs in support of it were purely negative

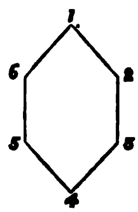
in character. In fact it was assumed that because only one mono-derivative with any element or radical was known, therefore only one was possible.

Accordingly it was desirable that some more exact demonstration should be given of the truth of such a fundamental assumption, and this has been recently accomplished by Ladenburg in the most complete and satisfactory manner. Ladenburg selects as the starting point of his experiments ordinary benzoic acid, which is to be regarded as benzol in which one atom of hydrogen is replaced by the monatomic carboxyl group C O O H, thus $C_6 H_5$ (C O O H). In this compound it is possible to substitute for one of the remaining hydrogen atoms the group O H, and by various means, into which it is not now necessary to enter, three isomeric oxybenzoic acids $C_6 H_4$ (O H) (C O O H) can be produced, all of which contain, or are reducible to, benzoic acid. Now as these three acids are, in the strictest sense of the word, isomeric, we can evidently only explain the differences between them by supposing that the relative positions of the two groups, O H and C O O H, in them are dissimilar: but as they all yield the same benzoic acid, the absolute position, if we may use the term, of the carboxyl group is fixed, and therefore that of the hydroxyl must vary. As we shall see subsequently, three is theoretically the greatest number of isomers possible for any disubstituted benzol. In these acids the carboxyl group is so loosely united to the nucleus, that it may be removed by simple methods, the hydrogen atom being left behind, and thus phenols produced. If, then, it could be shown that the phenols from these three sources were in every respect identical, and that from these again ordinary benzoic acid could be reproduced by substituting carboxyl for the hydroxyl, the equivalency of the hydrogen atoms would be placed beyond doubt. Ladenburg has instituted a careful comparison of these phenols, as regards fusing point, boiling point, and specific gravity, and he has found that they are absolutely identical with common phenol (carbolic acid) from coal tar.

It only remained, therefore, to show that from these benzoic acid could be obtained by reactions of such a nature that the introduced carboxyl group must, of necessity, occupy the place vacated by the hydroxyl. This Ladenburg has accomplished by first substituting bromine for the hydroxyl, by the action of phosphorous pentabromide, and from the resulting brombenzol, by the simultaneous action of carbonic anhydride and metallic sodium, forming sodium benzoate, from which ordinary benzoic acid is readily extracted. It must be mentioned that Hübner, some years before, had partially proved the same thing, by showing that the two isomeric nitro-brombenzols, $C_6 H_4$ Br (N O_2), obtained by nitrifying the same brombenzol, $C_6 H_5$ Br (in which consequently the nitro groups must occupy different positions relatively to that of the bromine), yielded by reduction (replacement of the oxygen by hydrogen), and removal of the bromine, the same, namely, ordinary aniline, $C_6 H_5$ (N H_2).

Thus I think we may regard it as proved that by the substitution of any element or radical for any one atom of hydrogen in benzol, the same compound is invariably produced, and consequently that the assumption of the symmetrical constitution of its molecule is justified. We have now to deal with derivatives in which two atoms of hydrogen are replaced either by the same or by different radicals. And here we discover the interesting fact that it is no longer a matter of indifference in what manner these compounds are prepared, but that the physical and, in a less degree, the chemical properties of those having the same chemical composition frequently vary with their origin. In other words, they are often isomeric and not identical. Now, remembering the fact which we have just seen proved, namely, the functional similarity of the six hydrogen atoms, we can only ascribe these differences to variations in the *relative* positions of the substituting groups. If we inspect the accompanying diagram, which represents the benzol "ring" as it is usually called, we shall find that there are only three relatively different positions which two groups could occupy in it. Designating the hydrogen atoms by the numbers 1, 2, 3, 4, and imagining one group to be introduced in the place of 1, we can see that a second group introduced at 2, 3, and 4, respectively, will in each case be differently placed with respect to the first. We may for the present omit from consideration Nos. 5 and 6, because they would be the same as Nos. 3 and 2. Thus theory indicates that three, and no more than three, isomers are possible for each disubstituted benzol. Now, up to the present time, in no well authenticated instance has a greater number been obtained for any one of them, and for many we are acquainted with that number. Thus three dinitrobenzols, $C_6H_4(NO_2)_2$, convertible by partial reduction into three nitranilines, $C_6H_4(NO_2)(NH_2)$, and by complete reduction into three phenylene-diamines, $C_6H_4(NH_2)_2$, three dihydroxylbenzols, $C_6H_4(OH)_2$, three dicarboxyl-benzols, $C_6H_4(COOH)_2$, three bromanilines, $C_6H_4Br(NH_2)$, &c., have been proved to exist. For other derivatives the known number of isomers is less than the theoretical, but to judge by the results of the past few years, the several lists will ere long be complete.

FIG. 2.



So far, then, theory and experiment agree remarkably well. Let us now see if we can advance a step further, and find out which hydrogen atoms are replaced in each derivative. And here it will be convenient to adopt the nomenclature at present current amongst chemists, and indicate by the prefix *ortho* those derivatives in which the hydrogens 1—2 are replaced, or more properly speaking, in which the introduced groups occupy adjacent positions in the nucleus, by *meta* those in which 1—3, and by *para* those in which 1—4, are substituted. In this inquiry obviously the first thing to be done is to classify all the known derivatives of benzol into series, each series consisting of those in which the substituting

groups undoubtedly are similarly situated. This, however, is by no means an easy matter; for in the first place the separation of isomeric substances bearing a strong chemical resemblance to each other, and differing, perhaps slightly, only in some physical property, such as fusing-point, boiling-point, solubility, state of aggregation, &c., is frequently an extremely laborious process; and, in the next place, the correspondence as regards constitution of two derivatives is only placed beyond doubt when one can be transformed into the other, or both into the same third, by reactions in which it is perfectly certain that the newly-introduced groups take the places of those eliminated. Such conversions, in some cases readily accomplished, in others are only to be attained by subjecting the bodies in question to a variety of chemical processes, which of course in a corresponding degree weakens the conclusions to be drawn from them.

Thus when a nitro group, $N\,O_2$, is converted by nascent hydrogen into an amido group, $N\,H_2$, the latter must evidently retain the place of the former; and the same may be said of the conversion of a methyl group, $C\,H_3$, into a carboxyl group, $C\,O\,O\,H$, by oxidation, of the change of a phenol into a chlorine or bromine derivative by the action of phosphorous pentachloride or pentabromide, and of the transformation of an amido compound into a phenol by the successive agencies of nitrous acid and water. On the other hand, no conclusions can be founded on such reactions as the conversion of a sulpho- or amido- into a nitro-derivative by the action of nitric acid, for in these cases there is no necessary connexion between the elimination of one group and the entrance of the other; they may be consecutive and not simultaneous phenomena.

It would be impossible in a short paper such as this, and indeed for my purpose unnecessary, to give even a general account of the labours of chemists in this direction. Suffice it to say that we are now able with tolerable certainty to refer each of the best known derivatives to its particular series. And here let me remark that once this is satisfactorily accomplished it will be sufficient, in order to determine the constitution of any series, to find that of any member of it, and that, having thus ascertained it for any two series, we necessarily infer it for the third.

Until within the last few years it was sought to accomplish this chiefly by reference to a certain number of compounds, whose structural formulæ were deduced from purely theoretical considerations. Thus in common dinitrobenzol, $C_6\,H_4\,(N\,O_2)_2$, formerly the type of the para or 1—4 compounds, and which is formed by the direct action of nitric acid on benzol, it was said that the two negative nitro-groups would, in virtue of their natural repulsion, tend to place themselves as far apart as possible in the molecule; and for a similar reason M. Kekulé assumed the 1—4 constitution for bromo-phenol and dibromobenzol. In β nitraniline on the other hand, the type of the ortho or 1—2 compounds, produced by nitrifying aniline, it was said that the mutual attraction of the negative

nitro- and the positive amido- group, would cause them to take up adjacent positions. An additional argument in favour of this latter view was found in the fact that by the oxidation of this β nitraniline quinone, $C_6 H_4 O_2$, was developed, in which it was said the two oxygen atoms must be in proximity, since they must be connected outside the ring: thus $C_6 H_4 \left\{ \begin{matrix} O \\ O \end{matrix} \right> .$ This production of quinone is, however, precisely one of those reactions from which, as I have pointed out, no conclusions can be drawn, and in fact quinone is now known to be produced by the oxidation of all three classes of derivatives.

It will not be necessary to go more at length into these older hypotheses, which often rested on fanciful analogies, and some of them on premises which have since been shown to be entirely false. Thus Hübner states that by nitrifying benzanilide two isomeric benzonitranilides are produced, which could not both be ortho; this fact at once disposes of the assumption from which the structural formula of β nitraniline was deduced. Moreover, Buff had previously shown that the disubstitution compounds corresponding to the formula $C_6 H_4 Br (H S O_3)$, obtained by the action of bromine on benzol-sulphonic acid, $C_6 H_5 (H S O_3)$, and of sulphuric acid on brombenzol, $C_6 H_5 Br$, are isomeric, whereas on the hypothesis of the repulsion of negative groups they ought to be identical; and, as I shall show further on, the impossibility of the para constitution for common dinitrobenzol has been placed beyond doubt.

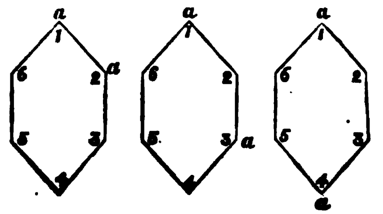
Although, then, the above considerations, or others of a similarly speculative nature, furnished the guiding principles for the structural classification of a large number of aromatic derivatives, it must be admitted that no great value was ever assigned to them, and that conclusions founded on them were only provisionally accepted by the majority of chemists. The constitution of the carboxyl derivatives alone was determined on more solid, because experimental grounds. Thus of the three dicarboxyl-benzols, $C_6 H_4 (C O O H)_2$, phthalic, isophthalic and terephthalic acids, one only, phthalic acid, on the application of heat parts with a molecule of water and yields an anhydride, $C_6 H_4 \left\{ \begin{matrix} CO \\ CO \end{matrix} \right> O$. A similar difference obtains between the isomeric carboxyl-hydroxyl-benzols $C_6 H_4 (O H) (C O O H)$, of which one only, salicylic acid, which can be otherwise proved to correspond to phthalic acid, is capable of furnishing an anhydride, $C_6 H_4 \left\{ \begin{matrix} CO \\ O \end{matrix} \right> .$ In these cases it is reasonable to assume that the possibility of the existence of these anhydrides depends upon the proximity in the molecule of the substituting groups, which must be connected through the medium of an oxygen atom. Of the remaining two dicarboxyl benzols Baeyer has shown that one, isophthalic acid, results from the oxidation of a dimethylbenzol $C_6 H_4 (C H_3)_2$, which may be procured by the removal of a

methyl group from mesitylene (trimethyl-benzol $C_6 H_3 (C H_3)_3$); and that this latter compound in consequence of its synthetic production from acetone must be symmetrical and therefore possess the 1—3—5 constitution; from which it follows at once that isophthalic acid must be a meta, and terephthalic acid a para, compound. Baeyer's ideas have recently received strong confirmation in the synthesis of mesitylene from allylene effected by Fittig and Schrohe.

Unfortunately the majority of benzol derivatives cannot be readily connected with the above compounds: their constitution must be to a great extent independently determined. Now in nearly all cases of substitution taking place by direct action, in which the action is not limited to the replacement of one hydrogen atom, it is found that two or more isomers are simultaneously generated; and the same in certain cases holds good when an additional group is introduced into an already monosubstituted or disubstituted benzol. Thus Würster has recently shown that by the prolonged action of nitric acid on benzol three isomeric dinitrocompounds are produced, convertible by partial reduction into the nitranilines already known. So also from the action of nitric acid on toluol, $C_6 H_5 (C H_3)$, two nitrotoluols, $C_6 H_4 (N O_2) (C H_3)$, from the action of chlorine on phenol two chlorphenols, $C_6 H_4 Cl (O H)$, result. Examples like these could be readily multiplied.

If we inspect the accompanying diagrams representing the possible varieties of disubstituted benzols (the letters *a* indicating *similar* groupings), we can see that by the introduction of a third lateral chain *b* into each we could get from the first,

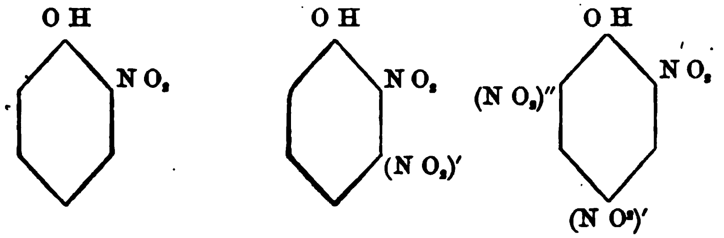
Fig. 3.



two isomers (*b* in 3 or 6 and 4 or 5), from the second, three (*b* in 2, 4 or 6, and 5), but from the third only one (*b* in 2, 3, 5 or 6). If, then, by acting on any disubstituted benzol we find that isomeric trisubstitution compounds result, this amounts, according to theory, to a positive proof that we have *not* to deal with a para-compound; and if we find that isomers are not produced, this affords ground for at least a strong presumption that the compound in question is a para derivative. Somewhat in this way Würster has recently shown that dinitrobenzol, so long regarded as a 1–4 compound, cannot be so; for the phenylene-diamine, $C_6 H_4 (N H_2)_2$, obtained by its reduction is also procurable by the reduction of two isomeric dinitrobenzoic acids, $C_6 H_3 (N O_2)_2 (C O O H)$, these substances losing $C O_2$ during the process. Hence these acids must be regarded as monoderivatives of the same dinitrobenzol, which would be impossible were this latter a para compound. It may, in fact, be shown that it is a meta (1–3) compound, as Salkowski has lately pointed out; for it is obtained from two isomeric dinitro-

phenols, $C_6 H_3 (N O_2)_2 (O H)$, by displacing the O H by hydrogen. The three bodies then contain the nitro-groups in the same relative position. But the two dinitrophenols are obtained simultaneously by acting with nitric acid on a nitrophenol $C_6 H_4 (O H) (N O_2)$, in which the substituting groups may be proved to occupy adjacent positions, and from which, therefore, only one *di*nitrophenol with ortho position of nitro-groups could be obtained. Thus

FIG. 4.

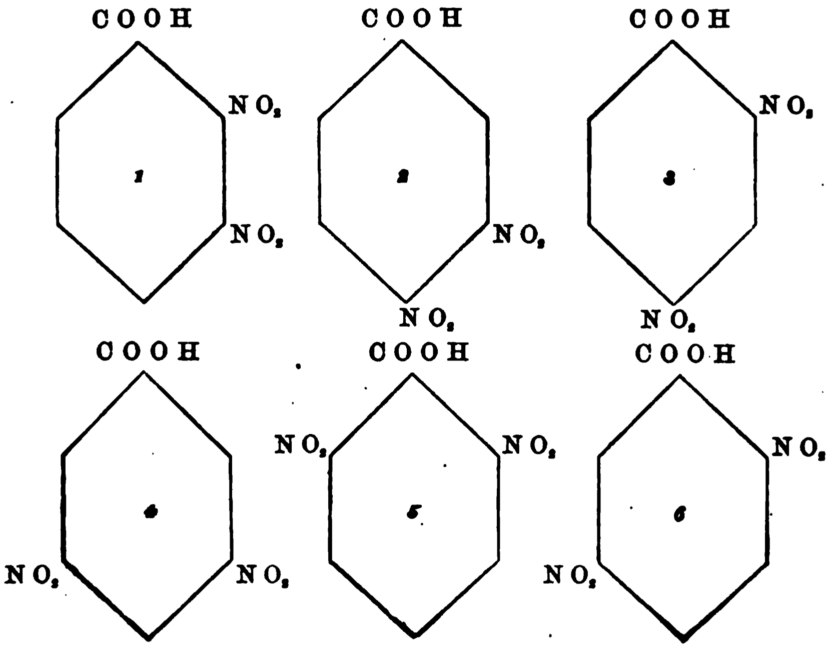


Nitro-phenol. One Dinitro-phenol with Orthonitro-groups possible. Two Di-nitro-phenols with Metanitro-groups possible.

Hence, since dinitrobenzol is neither ortho nor para, it must be meta.

A remarkable verification of the foregoing conclusions has been given by Griess. According to Kekulé's theory, six isomeric dinitrobenzoic acids are possible.

FIG. 5.



The last four of these are known, and Griess has himself described the diamido-acids, $C_6H_3(NH_2)_2(COOH)$, corresponding to the first two. From these acids it is easy to procure the corresponding phenylene-diamines, $C_6H_4(NH_2)_2$. From 1 and 2 we should obtain the ortho compound, the meta from 3, 4, and 5, and the para from 6. Griess has found that the three known phenylene-diamines are yielded by one, two, and three of these acids respectively, and that their structural formulæ thus deduced are the same as those previously arrived at.

So far we have no *direct* method of distinguishing ortho from meta derivatives, for the connection between carboxyl-compounds previously mentioned and nitro-substitution products is only with difficulty made out. This want, I think, we are now in a condition to supply, as follows :—

If from the molecule of an acid, such as acetic acid, C_2H_3O, OH, we remove hydroxyl, we obtain a monatomic radical, C_2H_3O; and if by any means we can further remove oxygen, a triatomic residue or radical, capable of replacing three atoms of hydrogen, will be the result. Now, diamines containing such triatomic residues have long been known, thus

$$\begin{matrix} C_6H_5N-H \\ C_6H_5N\equiv(C_2H_3)''' \end{matrix} \quad \text{and} \quad \begin{matrix} C_6H_5N-H \\ C_6H_5N\equiv(CH)''' \end{matrix}$$

The reactions by which they are obtained, and their properties, leave no doubt as to their constitution. It will be observed that the two nitrogen atoms are held together by the triatomic radical. There is then apparently no reason why similar compounds should not be obtained from phenylene-diamine $C_6H_4(NH_2)_2$, since in it we have two nitrogen atoms united to four replaceable hydrogens. Some years ago Hobrecker attempted their formation by the reduction of the corresponding nitramides resulting from the direct action of nitric acid on acetanilide and its homologues.

$$C_6H_5N<^{H}_{C_2H_3O} \quad C_6H_4(CH_3)N<^{H}_{C_2H_3O} \quad C_6H_3(CH_3)_2N<^{H}_{C_2H_3O}$$

The nitramides are thus represented :—

$$C_6H_4(NO_2)N<^{H}_{C_2H_3O} \qquad C_6H_3(NO_2)(CH_3)N<^{H}_{C_2H_3O} \quad \&c.$$

On submitting these to the action of reducing agents, he found that in the first a simple reduction of the nitro-group took place, a substituted phenylene-diamine resulting, $C_6H_4(NH_2)NH(C_2H_3O)$; or more properly speaking, he obtained the decomposition products of this body. In the other two nitramides a remarkable change took place. Not only the nitro group, but also the acid radical was reduced, thus giving the desired bases —

$$C_6H_3(CH_3)\left\{\begin{matrix} N-H \\ N\equiv(C_2H_3) \end{matrix}\right. \quad \text{and} \quad C_6H_2(CH_3)_2\left\{\begin{matrix} N-H \\ N\equiv(C_2H_3) \end{matrix}\right.$$

Subsequently to this I endeavoured to obtain similarly constituted bodies, starting, however, from a different nitraniline, the

so-called α compound (at that time regarded as para) produced by partial reduction of common dinitrobenzol, and an isomer of that from which acetnitranilide is derived. For one atom of hydrogen in the amido-group I substituted the radical benzoyl (C_7H_5O), and thus obtained a benzonitranilide, $C_6H_4(NO_2)NH(C_7H_5O)$. By the action of reducing agents upon this I could only obtain a substituted phenylene-diamine, $C_6H_4(NH_2)NH(C_7H_5O)$.

Shortly afterwards Hübner and Retschy announced that by the reduction of an isomeric benzonitranilide obtained by nitrifying benzanilide, they had procured the base which I had vainly sought—$C_6H_4\left\{\begin{matrix} N-H \\ N\equiv C_7H_5 \end{matrix}\right.$. I accordingly repeated my experiments under varying conditions, but with the same results as before. Hübner and Stöver have since closely investigated the action of nitric acid on benzanilide, and have found that in this reaction two isomeric benzonitranilides are produced, one of which, by reduction, yields the above-mentioned oxygen-free base, while the other simply gives a substituted phenylene-diamine. They have found, moreover, that the nitranilide which yields the oxygen-free base is a derivative, not of β nitraniline, as in Hobrecker's experiments, nor of α nitraniline, as in mine, but of a third recently-discovered and but little known isomer, now recognised as ortho-nitraniline. I had previously to this experimented with the benzonitrotoluide corresponding to α benzonitranilide, and I have since tried the action of reducing agents on the α and β nitranilides of salicylic acid, and I am perfectly convinced that in none of these is the acid radical reducible. I have in each case obtained the corresponding phenylene-diamine. I should mention that the second benzonitranilide obtained by Hübner, in which the radical benzoyl is unaffected by reducents, proves to be a derivative of β nitraniline corresponding to Hobrecker's acetnitranilide.

The explanation of the results of all these experiments is now not difficult to find. Benzoic acid is, as we have seen, a carboxyl derivative of benzol $C_6H_5(COOH)$. By removing hydroxyl we get the monatomic radical $(C_6H_5-CO)'$ which exists in benzonitranilide, and by reduction the triatomic residue C_6H_5-C''' existing in Hübner's base. In this radical, for which the name benzenyl has been proposed, the three free affinities belong to one carbon atom, which, therefore, in benzenyl-phenylene-diamine (Hübner's base) must be directly connected with both nitrogen atoms, thus: $C_6H_4\left\{\begin{matrix} N-H \\ N\equiv C-C_6H_5 \end{matrix}\right.$. This, of course, is only possible when the nitrogen atoms occupy neighbouring positions in the phenylene-diamine—that is, in orthophenylene-diamine, and must be impossible in the case of its isomers, in which the amido groups are widely separated.

There is little doubt but that the nitrotoluidine and nitroxylidine procurable from the higher nitramides with which Hobrecker

experimented, will prove to contain the nitro and amido groups in the ortho position. That, as regards these, they should have a different structure from the nitraniline, obtained in precisely the same way, need not surprise us when we remember that, whereas aniline contains but one lateral chain, toluidine contains two and xylidine three, which, of course renders the conditions of experiment different in each case.

In the foregoing results I think we have the best proof of the ortho constitution of the recently discovered nitraniline, and hence of the numerous compounds into which it may be converted or from which it may be derived.

I do not propose now to enter upon a discussion of the ultimate atomic structure of the higher derivative of benzol, because our knowledge of their mutual relations is still very limited. It will be at once obvious that the same considerations, in a slightly modified form perhaps, will be applicable to them as to the disubstitution compounds.

To assert that, even in the case of benzol, the ultimate arrangement of atoms has been reached, would be presumptuous; but that in the theory which I have endeavoured to explain we have at least a representation of it there can be little doubt. That Chemistry alone can gain for us an insight into the constitution of matter in general, is highly improbable; nevertheless, the gigantic strides which Science has made within the present century may well inspire us with the hope that the solution of this great problem by the combined efforts of the chemist and physicist will be merely a question of time.

XII.—*Some Points in the Chemistry of Milk.* By CHARLES A. CAMERON, M.D., Fellow and Professor of Chemistry and Hygiene, Royal College of Surgeons; Lecturer on Chemistry and Geology, Government Agricultural Institution, Glasnevin; Analyst to the City of Dublin, the Royal Agricultural Society, &c., &c.

Read Monday Evening, January 18th, 1875.

THE CAUSE OF THE COLOUR OF MILK.

The white appearance presented by milk is generally attributed to the circumstance that this liquid is an emulsion of fats in a solution of saccharine and albuminous substances. Viewed under the microscope, milk appears to be a colourless liquid, in which are suspended numerous globular bodies, which have been shown to consist nearly altogether of fatty substances. Henle was the first to prove that these so-called fat globules have albuminous envelopes, an observation since confirmed by Lehmann, Moleschott,

and others. I have examined freshly drawn milk with very high microscopic power (1-30 inch focal length), and I find that it contains globules of fatty matter unprovided with membranous capsules. They vanish instantly on the addition of chloroform or anhydrous ether, whilst the globules with envelopes resist the action of these solvents, unless treated also with caustic potash. The fat globules unprovided with investing membranes are in cow's milk, with few exceptions, smaller than those with envelopes, and rarely exceed 0·0015″ in diameter. Sometimes they occur abundantly; occasionally they are nearly absent. By violently agitating milk with ether or chloroform for some time the capsules containing the fats are to some extent ruptured, and their contents set free and dissolved by the ether or chloroform. All the fatty matter cannot, however, be extracted in this way. In the ordinary process of churning the capsules are broken up, and the fats contained in them, being specifically lighter than the other constituents of the milk, ascend to the surface of the liquid to be gathered up as butter. When milk is allowed to rest for some hours most of the so-called fat globules ascend and constitute cream; but they do not ascend nearly so rapidly as the free fats produced by churning, and, therefore, the specific gravity of the former is greater, owing evidently to their caseous envelopes.

The results of some experiments which I have made convince me that the colour of milk is due not to its being an emulsion of fats, but to the immense number of solid caseous particles which it includes. These objects are so minute that it is difficult to observe the intimate nature of their structure. They appear, however, to be white and translucent, but not transparent—or rather, they appear to be semi-translucent, semi-transparent. They refract and reflect the light which penetrates the milk, and produce in great part the optical appearance presented by that liquid. There are several reasons which lead me to believe that it is the insoluble casein investing the fats, and not the latter, which produce the opacity of milk. In the first place, no emulsion of fats with solutions of sugar and albumin simulates the optical properties of milk; secondly, skimmed milk is not so white as buttermilk, and yet it contains from 1·5 to ·2 per cent. of fats; whilst buttermilk includes only from 0·5 to 0·8 per cent. of fats. Buttermilk, containing only 1·200th part of its weight of fats, is a perfectly white and opaque liquid, and it is absurd to suppose that these optical properties are due to the presence of so minute a trace of fats. On the contrary, they are caused by the presence of innumerable particles of solid caseous matter. Skimmed milk is certainly less opaque than new milk, but, then, the cream removed from the former contains a large proportion of solid caseous matter. Lastly, if freshly drawn milk be rendered decidedly alkaline by the addition of solution of caustic potash, and digested for 24 hours with ten times its volume of boiling ether, all, or all save a trace, of the fats will be dissolved. If the ether be separated, a white non-fatty liquid resembling milk will be left.

COMPOSITION OF COW'S MILK.

The results of thousands of analyses of cow's milk which I have made during the last eleven years have convinced me that the mixed milk of a herd of cows never contains less than 12 per cent. of solids if the animals are owned by dairymen, or 11·5 per cent. if pastured on poor farms. More frequently the amount of solids in Dublin milk (when pure) is above 13 per cent. than below that proportion. Occasionally it rises to 16 per cent., even when no colostrum is present. In forty specimens of milk, each drawn from an individual cow, which I examined in 1866, the solids varied from 12·4 to 15·68. In each case I saw the milk drawn from the cow, and the specimen examined was part of a full milking. I have found no difference between Dublin milk in summer or winter with respect to the amount of solids. The following I believe to be the average composition of the milk of Dublin dairy cows:—

One hundred parts contain—

Water,	87·00
Fats,	4·00
Albuminous Matters,	4·10
Sugar,	4·28
Mineral Matter,	0·62
	100·00

Several hundreds of convictions for the sale of adulterated milk have been obtained in Dublin since 1865, and in each case pure milk was assumed to contain 11·5 per cent. of solids, and at least 2·5 per cent. of fats. In all the prosecutions that have taken place under the provisions of the last anti-adulteration Act, a sealed portion of the milk analysed was produced in court, and the defendant had the opportunity of having it re-examined by another analyst, but invariably declined having it done, even when the milk was alleged to have been adulterated with but 12 per cent. of water. Last June a raid was made upon the contractors who supply the Curragh Camp with milk, and fourteen specimens collected were handed to me for analysis. Several were found to contain from 9 to 11 per cent of solids. Another raid was made immediately after the conviction of the vendors of the watered milk, but in the twelve specimens collected the solid matters varied from 12·4 to 13·6 per cent. Wherever, in short, I have had reason to believe that milk was pure, I never found it to contain less than 12 per cent of solids. I agree, therefore, with Mr. Wanklyn when he states that the solids in pure milk are never less than 9·3 per cent., minus the fats.

COMPOSITION OF MARE'S MILK.

A liquid termed Koumis, long employed as a favourite beverage amongst the Tartars, has recently come into use, though not largely, as a remedial agent. It consists of the fermented milk of the mare, a liquid very rich in sugar. On looking through the

scientific books and journals for an account of the composition of mare's milk, I was struck by the remarkable discrepancies between the results of the analyses of the chemists who have examined this secretion. Simon, in his Animal Chemistry, says that mare's milk is very rich in solid matters. Gorup-Besanez,* in his recent work on Physiological Chemistry, and which is highly esteemed amongst German chemists, as embodying the most recent results obtained in that department of knowledge, gives the following as the average composition of mare's milk:—

One hundred parts contain—

Water,	82·837
Fats,	6·872
Casein, &c.,	1·641
Sugar, Mineral Matter,	8·650
	100·00

Clemm, who has made numerous analyses of milk, states that mare's milk is very rich in solids, and contains nearly 7 per cent. of fats. Payen's account of mare's milk is exactly opposite to that of all the foregoing. He found it to contain:—

Water,	89·33
Fats,	0·20
† Casein,	1·72
† Sugar,	8·75
	100·00

The results of ten analyses of mare's milk‡ which I have recently made, gave results very near those arrived at by Payen, but totally different from those of Clemm, Simon, and others. I found the per-centage of solids to vary from 8·5 to 11·5, the fats from 0·6 to 2·12, the casein from 1·46 to 2·40, the sugar from 5·26 to 6·87, and the mineral matter from 0·33 to 0·44.

COMPOSITION of MARE'S MILK.

100 parts of each contain—

—	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.
Water,	90·10	90·06	90·00	90·70	88·50	90·10	90·86	90·42	90·86	91·50
Fats (butter),	0·99	1·08	0·98	0·88	2·12	1·20	0·96	0·86	0·88	0·60
Cheesy matters,	1·78	1·94	1·89	1·92	2·07	2·09	2·09	2·09	2·20	1·46
Sugar,	6·69	6·52	6·73	6·08	6·89	6·28	5·67	6·23	5·68	6·08
Mineral matter,	0·44	0·40	0·40	0·42	0·42	0·33	0·42	0·40	0·38	0·36
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Solids,	9·90	9·94	10·00	9·30	11·50	9·90	9·14	9·58	9·14	8·50
Water,	90·10	80·06	90·00	90·70	88·50	90·10	90·86	90·42	90·86	91·50

* *Lehrbuch der Physiologischen Chemie.* Second edition, page 416.

† Including mineral matter, ·04.

‡ The greater number of the specimens were supplied to me by Dr. Sack, the Resident Physician at the Hydropathic Establishment, Blarney, Co. Cork.

The average composition of the ten specimens is as follows:—

Water,	90·310
Fats,	1·055
Cheesy Matters,	1·953
Sugar,	6·235
Mineral Matter,	0·397
	100·000

The milk of the mare is bluish white, and its specific gravity is about 1·031; its reaction when perfectly fresh is either neutral or faintly alkaline.

SOW'S MILK.

I have been able to discover only one investigation into the composition of the milk of the sow—made by Scheven—and which showed that it was about as rich in solids as cow's milk, but very poor in fats. Two analyses of sow's milk which I have made gave very nearly similar results, and those were very different from Scheven's. The first was made in 1858, the second last month. The following are the compositions of each:—

	1st.	2nd.	Mean.
Water,	81·80	81·72	81·760
Fats,	6·00	5.66	5·830
Casein,	5·30	7·06	6·180
Sugar,	6·07	4·60	5·335
Mineral Matter,	0·83	0·96	0·895
	100·00	100·00	100·00

The colour of sow's milk is white inclining very slightly to yellowness. Its reaction is very faintly alkaline, and its specific gravity 1·041.

In drying sow's milk on the water-bath, the odour of roast pork which it exhales is quite remarkable; and when it becomes putrid, its odour resembles exactly that of rotten bacon. Another peculiarity of sow's milk is that in the lactometer it throws up no cream, in which respect it differs from every kind of milk which I have ever examined.

COMPOSITION of the MILK of different ANIMALS.

1,000 parts contain—

—	Water.	Butter.	Cheesy Matter.	Sugar.	Mineral Matter.
Woman,	889·08	26·66	39·30	43·68	1·30
Cow,	87·00	4·00	4·10	4·28	0·62
Goat,	844·90	56·87	35·14	36·91	6·18
Ewe,	832·32	51·31	69·78	39·43	7·16
Mare,	90·310	1·055	·953	6·235	0·397
Ass,	890·12	18·53	35·65	50·46	5·24
Sow,	817·60	58·30	61·80	53·35	8·95

Proportions of Solids and Water in different kinds of Milk.

—	Woman.	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Water, . .	889·08	864·20	844·90	832·32	90·31	890·12	817·60
Solids, . . .	110·92	135·80	155·10	167·68	9·69	109·88	182·40
	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00

A comparison of the composition of the milk of the sow with that of other animals, shows how rich in solid matters the former is.

The analysis of the milks was conducted as follows :—

A.—A weighed portion of the milk was acidulated with a little acetic acid, to prevent the formation of a skin, mixed with pulverized quartz (which had previously been boiled in hydrochloric acid, washed, and ignited), and evaporated to dryness on the water-bath. The weight of the residue—quartz, showed the amount of solid matters in the milk.

B.—The residue was repeatedly treated with boiling anhydrous ether, by which the fats were dissolved. The ether was evaporated, and the residue of fats weighed.

C.—The substance from which the fats were removed was subjected to a nitrogen combustion, and from the amount of nitrogen obtained the proportion of albuminous matter was deduced in the usual manner.

D.—The sugar was determined by the copper method.

E.—Five grammes of the milk were evaporated to dryness, and the residue burned at a low temperature. The amount of mineral matter, or ash, was thus determined.

XIII.—*On the Rational Estimation of Nitrogen in Manures.* By Charles R. C. Tichborne, Ph.D., F.C.S., M.R.I.A., &c.

[Read Monday Evening, January 18th, 1875.]

In the determination of nitrogen in manures, the process universally adopted is its combustion, and the ultimate resolution of its nitrogenous components into ammonia, and upon this datum is based the calculation of the money value as regards this important element. The nitrogen being calculated as ammonia, and estimated according to the market value of sulphate of ammonium.

That such a method is more or less fallacious, has been tacitly acknowledged for some considerable time; but no practical method has been adopted, by which this erroneous system might be remedied. I now submit a method which, at any rate, presents some rational phases.

It is based upon the conversion of amide substances into their

ultimate products by treating them with hypobromite of sodium. The result is always a greater or less destruction of the nitrogenous molecule, resulting in the production of a certain amount of nitrogen. How far this will be carried out will depend upon the stability of the particular nitrogenous molecule under treatment, and such a reaction will be a measure of the decomposability of the nitrogenous matter, and likewise of its value as a fertilizer. The action of the hypobromite being most marked upon the amide structure.

The exception to these remarks will be the nitrates which in any manure should be estimated separately.

The hypobromite of sodium has been, so far, only used for estimating urea in urine, but the objections that have been raised to its use for this purpose have caused me to make use of it for the "rational estimation of nitrogen in manures."

The objection is, that the alkaline hypobromites and hypochlorites act in a more or less degree upon the other nitrogenous constituents of the urine. How differently it acts upon these products will be seen from the subjoined table, in which the actual per-centage of the entire nitrogen which is decomposable is given. It will be seen from the table that whilst urea (the chief nitrogenous constituent of urine) is nearly all decomposed, or split up into nitrogen, that is to say, 92 per cent. of the entire of that element present, wool only yields 4 to 12 per cent. of its nitrogen, as being decomposable.

PER-CENTAGE of the NITROGEN yielded on treatment with the HYPOBROMITE of SODIUM.

Sulphate of ammonium $(NH_4)_2 SO_4$ (Tichborne),	100
Urea, $CH_4 N_2 O$ (Leconte),	92
Creatinine, from guano, $C_4 H_7 N_3 O$ (Russell and West),	75
Uric acid, $H_2 C_5 H_2 N_4 O_3$ (Tichborne),	66
Hippuric acid, $HC_9 H_8 N O_3$ do.,	17·5
Guanine, $C_5 H_5 N_5 O$ (Tichborne),	12·8
Gelatine, 18·34 per cent. of N (Tichborne).	4·1
Gelatine after being rendered soluble by potash (Tichborne),	12·3
Wool (Tichborne), 17·93 per cent. N,	8·8

Wool, and such like substances, have been, and are still used in the production of manures, yet the analytical chemist would return the nitrogen in such a manure as having the same money value as Peruvian guano.

Gelatine frequently enters into the composition of artificial manures, and swells the per-centage of so-called ammonia, yet it would appear that gelatine has but a limited decomposability, as compared with many other nitrogenous substances.

In speaking of urea and wool, I have put extreme cases for the purpose of illustration, but the action of the hypobromite solution is thoroughly borne out by observation as regards the decomposition in the ground. We find that under advantageous circumstances, urea becomes converted into carbonate of ammonium in

twenty-four hours, whilst hair, and such like products, as we know from the experience gained in graveyards, are the last of the animal products to decompose.

I use pure and dry sulphate of ammonium as my basis for calculation. I find that on treating it with the hypobromite solution, ·1 gramme yields 17·5 C C of nitrogen, or practically the whole of its nitrogen; but it must be borne in mind that the money value is supposed to refer to a commercial article, containing 24 per cent., $N H_3$, whilst the theoretical per-centage would be 25·75, so that as

$$\frac{17{\cdot}5 \times 24}{25{\cdot}75} = 16{\cdot}31$$

we may say that 16·31 C C, represents ·1 gramme of commercial sulphate of ammonium (24 per cent.) Now on treating a given sample of manure in this manner, it is easy to calculate accordingly 16·31 C C of nitrogen gas evolved representing (when a gramme of manure has been treated) nitrogenous molecules, having a money value equal to 10 per cent. of sulphate of ammonium, viz.:—Whatever might be the market price of the day. I should recommend that in each analysis, the total nitrogen should be taken by a combustion, and also the nitric acid separately estimated if present. In the case of most manufactures of manures using sulphate of ammonium, blood, urine, fæces, or in guanos, such a method of calculation would tend to increase the money value; in some others deteriorate them.

Alkaline permanganate of potassium is not a suitable oxidizing substance. No gas is given off in the cold, on treating ammoniacal salts with such a solution, thus bearing out Wanklyn's views derived from experiments performed upon ammonia and the amides, with heat in sealed tubes, in which the amides yielded nitrates on oxidation, with alkaline permanganate. Urea, it is true, gives up parts of nitrogen, as such, according to the same authority, and from this reason is not classed as a carbamide, but is formulated on the type of marsh gas; so—

$$C\left\{\begin{array}{lcl} H & \ldots & (NH)'' \\ H & \ldots & C\,NH_2 \\ H & & \\ H & \ldots & OH^{*} \end{array}\right.$$

It is evident that the analytical power of the hypobromite is quite distinct, because urea behaves as an amide, when treated with that substance in the cold.

The instrument I propose to use in the application of the hypobromite solution is similar to that used by Messrs. Russell and West for the examination of urine.* With two very important modifications which will be found almost absolutely necessary as

* Wanklyn and Gamgee on the action of permangate of potash on urea, ammonia, and acetamide.—"Journal of the Chemical Society," vol. vi., p. 25, new series.

† "Journal of the Chemical Society," page 750, vol. xii.

regards its use with solid substances, such as guano, or artificial manure. The original apparatus, essentially consists of a tube with a bulb, for treating the substance with hypobromite solution, a water trough into which this tube is fixed and a graduated tube for measuring the evolved nitrogen. The modifications which I propose in the instrument are the following:—The tube for treating the substance with the hypobromite solution is made in two parts, the bulb being separate and fitting into the elongated part by an India-rubber stopper. The advantage of having the bulbs separate when we are dealing with a solid, both as regards the introduction of that solid, and the subsequent cleaning, is self-evident, and in such a case as guano or manure it will be found desirable to add to the weighed material in a small mortar, one or two C C's of water, when well mixed to add a few drops of liquor potassa, and at once to transfer to the bulb, and to rinse the mortar twice with small portions of water, which are to be added also to the contents of the bulbs.

The hypobromite is then found to work much more regularly upon guano. I should also propose, if practical, to substitute a glass stop-cock at the constriction of the tube, instead of the plug formed by the end of a rod. The remainder of the tube is then filled with the hypobromite of soda solution, the constriction being closed, and the trough filled with water. The graduated tube also filled with water is then brought over the mouth of the tube, and on opening the communication between the hypobromite and the guano, the evolution of gas at once commences. I have the tube graduated in C.C., and here also I have introduced an important modification. At the top of the graduated tube is a little cup, communicating with the interior by a stop-cock.

In dealing with a miscellaneous collection of substances, it frequently happens that there is a considerable delay in the subsidence of the froth, and we cannot read off the amount of nitrogen liberated, until this takes place. This froth is very persistent with some of the manures; but this source of trouble is instantly and perfectly remedied by the above contrivance. A little alcohol is placed in the cup, and when the evolution of the gas is at an end, the stop-cock is slightly opened, so as to allow a drop or so of alcohol to enter the graduated tube, which it does, by virtue of the suction, enduced by the column of liquid still remaining. The froth instantly subsides; so quick is the reaction, that the vapour of the alcohol seems to do the work. If the quantity of the gas in the tube is small, it is better to bring it to the water level before reading it by letting it down into an arrangement specially provided in the bath, for this purpose. If the trough is filled with water at 15 C, this will eliminate error as regards temperature, or, at any rate, sufficiently for all practical purposes, and a difference of $\frac{1}{10}$ of an inch in the barometer represents very little in the value of sulphate of ammonium. If the substance is extremely rich in amides, ·5 grammes will be sufficient to operate upon; but as a rule 1 gramme is a more desirable quantity.

XIV.—*On Specimens of Osteocella Septentrionalis,* presented to the Museum of Natural History. By EDWARD L. MOSS, M.D., F.R.C.S.I., Surgeon of H.M.S. *Alert,* Arctic Expedition.

THE specimens of Osteocella Septentrionalis which I have the honour of exhibiting this evening were obtained by me eight months ago from Burrard's Inlet, at the north mouth of the Frazer river. I forwarded them by H.M.S. *Fawn* to Dr. Carte. They reached Dublin on Friday last, and I have now the opportunity of personally presenting them to the Natural History Museum of the Royal Dublin Society. When the specimens reached me their soft parts were somewhat disintegrated, but fortunately not so much so as to interfere with the description and classification of the then unknown organism whose wand-like skeleton had been named by Gray Osteocella Septentrionalis.

Many attempts have been made from time to time to preserve the creatures in a state fit for examination on their arrival in Europe. All have failed, and I have only the hard central axes to present to you.

All sorts of theories were afloat as to the nature of the animal supplying the rods. Some said it might be the bone of a gigantic ray; others that it was the dried notochord of some low fish—perhaps a chimæroid.

Professor Kölliker was the first to suggest that it might be the sclerobasis of some unknown Alcyonarian, and such it has turned out to be.

Several zoologists, both in England and Germany, endeavoured to obtain at least sketches of the animal in its recent state, and at length an illustration appeared in "Nature," vol. vi., page 436, representing the desired beast as a fish with a head, mouth, and eyes. The sketch is altogether an example of the unscientific use of the imagination; the creature is not only not a fish, but not a vertebrate.

The specimens that reached me enabled me to supply the description of plate, which are published in the "Proceedings of the Zoological Society," November, 1873, and to identify the creature as a sea-pen of the genus Virgularia. It is not far removed from the Virgularia glacialis which Sars found off the Norwegian coast. Its length, though unusual, was exceeded by that of a distant relative—a Funiculina dredged up by H.M.S. *Terrible* in fishing for the lost Atlantic cable of 1858.

XV.—*On Selenium.* By RICHARD J. MOSS, F.C.S.

[Read Monday Evening, March 15, 1875.]

THE scarcity of Selenium is probably the reason why some remarkable properties of the element have long remained unknown. Modern text-books contain but little information about it in addition to that published by Berzelius, the illustrious discoverer of this metalloid. Just two years ago Mr. Willoughby Smith was the first to announce that the electrical conductivity of a bar of crystalline selenium was greater when the bar was exposed to light than when it was in darkness. In conjunction with Mr. Harry Draper I have been engaged in an investigation of this anomaly. I purpose giving a brief account of some facts observed in the course of our research.

Selenium has been very properly classed between sulphur and tellurium. It is not such a true metalloid as sulphur, while it exhibits less metallic characteristics than tellurium. Its physical properties, however, are subject to remarkable variations. Doubtless the close analogies which selenium presents to sulphur induced Berzelius to try if it was electrically excited by friction. He concluded that it was unlike sulphur in this respect. This result is remarkable, as the element in its vitreous condition is as perfect a non-conductor of electricity as sulphur. According to Bonsdorff, selenium can be rendered electrical by friction in very dry air. Numerous experiments have proved that the observation of Berzelius is erroneous; also that very dry air does not appear to be essential; for, out of a large number of trials made on different occasions, and under various atmospheric conditions, I have not observed a single instance of the electrical equilibrium being undisturbed by friction. I have frequently rendered a rod of vitreous selenium highly electrical by drawing it through my fingers. It is possible that Berzelius's experiments were not made with truly vitreous selenium.

It has long been known that selenium, like several other metalloids, exhibits the phenomenon of allotropy. At temperatures between 90° and 200° C., vitreous selenium passes into a new state. Instead of a vitreous fracture, it now exhibits a granular appearance when broken. In this condition its fracture bears a striking resemblance to the metal cobalt. The transformation is dependent upon time as well as temperature. At 90° C. four or five hours must elapse before the change takes place, while experience has shown that, in order to convert vitreous into granular selenium at 100° C., it must be kept at this temperature for at least three hours. The alteration has sometimes apparently taken place in a shorter time, but I have observed in such cases that some portions of the bars experimented upon were not thoroughly granular. It is not improbable that the variations observed in the time required to produce this modification, at any given temperature,

arise from difference in the condition of the vitreous selenium employed. Considering that selenium, slowly cooled from its melting point, passes into the granular state, while that quickly cooled becomes vitreous, it is probable that an intermediate rate of cooling may produce a substance highly susceptible of molecular change. The difficulty of distinguishing between different stages of granularity makes it hard to settle this point experimentally.

In attempting to verify Smith's statements with granular selenium produced at 100° C., a difficulty occurred. It did not conduct electricity at all. Even the smallest fragments which could be conveniently manipulated, when placed in the circuit of ten Leclanché elements, with a highly sensitive galvanometer, failed to show any evidence of conductivity. The experiment was repeatedly tried, but always with the same result. This granular form of selenium appears to be as bad a conductor as the vitreous modification. It differs from the latter, however, in being incapable of electrical excitation by friction. The fact that selenium converted into the granular form at 100° C. does not conduct electricity has not been previously observed.

Hittorf states that the transformation of selenium from the vitreous to the granular state is facilitated by increased mobility within the mass of the substance. Now, between ordinary temperatures and 250° C. the metalloïd exhibits every stage of condition—from perfect solidity to perfect fluidity. At ordinary temperatures it is hard and brittle, and remains permanently vitreous. At 100° C. it is plastic, and may be rolled out or flattened into plates. If the temperature be increased with sufficient rapidity, it passes into the condition of a mobile liquid, and rapidly volatilizes. If, then, instead of allowing it to assume the granular state at 100°, a greater facility for transformation is afforded by maintaining it, say at 180°, the granular modification is quickly produced. Although this granular form is precisely the same in appearance as that produced at the lower temperature, there is one important difference between them. The new form conducts electricity, and exhibits the phenomenon of increased conductivity under the influence of light. When compared with the metals, however, its conductivity is exceeding low. In this condition selenium bears a stronger physical resemblance to tellurium than it does to sulphur. It is interesting to note the gradual transition of selenium from the metalloidal to the metallic state.

The electrical properties of the conducting modification are subject to remarkable variations. It sometimes happens that in attempting to prepare two bars as similar as possible in their electrical properties, one will exhibit a resistance many times greater than the other. Under such circumstances, the bar having the greatest resistance is often far more sensitive to light than the one which exhibits a comparatively high conductivity. But after exposure to light it loses this peculiarity to a great

extent, and passes into the more highly conducting and less sensitive form. Selenium of comparatively high conductivity is but little influenced by light. It is probably in the molecular state into which light converts selenium of lower conductivity.

When warmed by radiation, all the conducting forms exhibit an increased resistance, thus further bearing out the resemblance to the metals. The opposite action of heat and light is remarkable, especially when it is considered that conducting selenium is most sensitive to the radiations situated in the extreme red of the spectrum, this being the warmest part of the visible spectrum.

Cobalt Chloride as a Moisture Test. By RICHARD J. MOSS, F.C.S., Keeper of the Minerals and Analyst, Royal Dublin Society.

[Read Tuesday Evening, April 20th, 1876.]

IT has long been known that hydrated cobalt chloride readily parts with water, and in doing so exhibits a marked alteration in its influence upon light. In the hydrated state it is carmine coloured, while in the anhydrous condition it is blue. Bibulous paper which has been moistened with a solution of cobalt chloride and then dried, exhibits at ordinary temperatures, a colour varying from pink to deep blue, according to the amount of aqueous vapour in the atmosphere. On this principle the so-called chameleon barometer has been constructed; it does not appear to have attracted as much attention as it deserves. Mr. A. P. Smith recently communicated to the *Chemical News** some observations on this subject, and showed that when compared with the indications of the wet and dry bulb thermometers, cobalt chloride paper was fairly trustworthy as a hygrometer at ordinary temperatures. For some time past I have observed the variations in the colour of a piece of this paper, and have been surprised to find that they are sufficiently marked for all ordinary purposes. A variation of ·5° C. in the readings of the thermometers is accompanied by unmistakable change in the colour of the paper, provided the air is not either very dry or very moist. In extreme cases the indications of the paper are not trustworthy, simply because, like all other colour tests, slight changes of colour are differently regarded by different persons, and even by the same person when observed under different light-conditions or at considerable intervals. This application of the paper is not, however, the one to which I wish to direct particular attention. In chemical manipulation one has frequent need of some easy way of determining whether air and various gases are moist or dry. To take a familiar example, it is of some importance that the air in a balance case should be moderately dry, and it is usual to place

* Vol. xxxi., p. 88.

some desiccating substance inside the case for the purpose of attaining this object. So far as I am aware it is generally taken for granted that no further precaution is necessary, indeed there has not been any convenient means of ascertaining whether the usual methods of desiccation are efficacious or not. This is one of those cases in which I believe cobalt chloride paper is likely to be of some considerable value. I find by employing this paper that the air in the interior of a balance case containing a beaker of sulphuric acid, is occasionally more moist than the outside air, thus indicating the necessity for further precautions. The application of the test in such an instance as this, is very simple. It is only necessary to place a slip of the paper in any convenient place inside the case, and I would suggest another slip outside the case. As long as the inside paper exhibits a blue tint the air is sufficiently dry to prevent the rusting of any of the steel parts of the balance, or to interfere with weighing operations. When, however, the paper exhibits a pink colour it indicates the presence of a considerable quantity of moisture, and therefore the need of more effectual desiccation. I have also found the paper very useful for indicating the condition of the air in desiccators such as are usually employed in analytical work. If they should happen to get out of order, either through accident or want of attention, the blue colour of the slip of cobalt chloride paper, placed in a conspicuous position inside the bell-glass, fades to an extent proportional to the quantity of moisture present. The paper is capable of several other applications of a useful nature. Dry air and dry gases are frequently required in chemical and physical experiments, and it is often unsatisfactory not to have some simple means of controlling operations intended to remove all moisture. I have already found the indications of the cobalt chloride paper of great service in this way.

The mode of applying the test already referred to is the most convenient for general purposes; but cotton-wool may occasionally be substituted for the bibulous paper with advantage. If it is desired to test a gas which has to be passed through a glass tube, a small piece of cotton-wool moistened with cobalt chloride and then dried, may be placed in the tube. I have found it best to employ a very small quantity of wool, and it should be placed loosely in the tube, not packed into it, in order to obtain immediate indications. Of course the test cannot be applied to gases which act chemically on the cobalt chloride, and moreover it is only adapted for ordinary temperatures, as cobalt chloride is anhydrous at high temperatures even in the presence of aqueous vapour. The sensitiveness of the paper or wool greatly depends upon the quantity of the salt employed to colour it. The most satisfactory results that I have obtained have been with paper and wool, moistened with a solution of one part of the hydrated chloride in ten of water.

On the Results of Injuries to the Spines of Echini. By H. W. MACKINTOSH, B.A. *With plate.*

Being the substance of a discourse delivered on Monday evening, April 25, 1876.

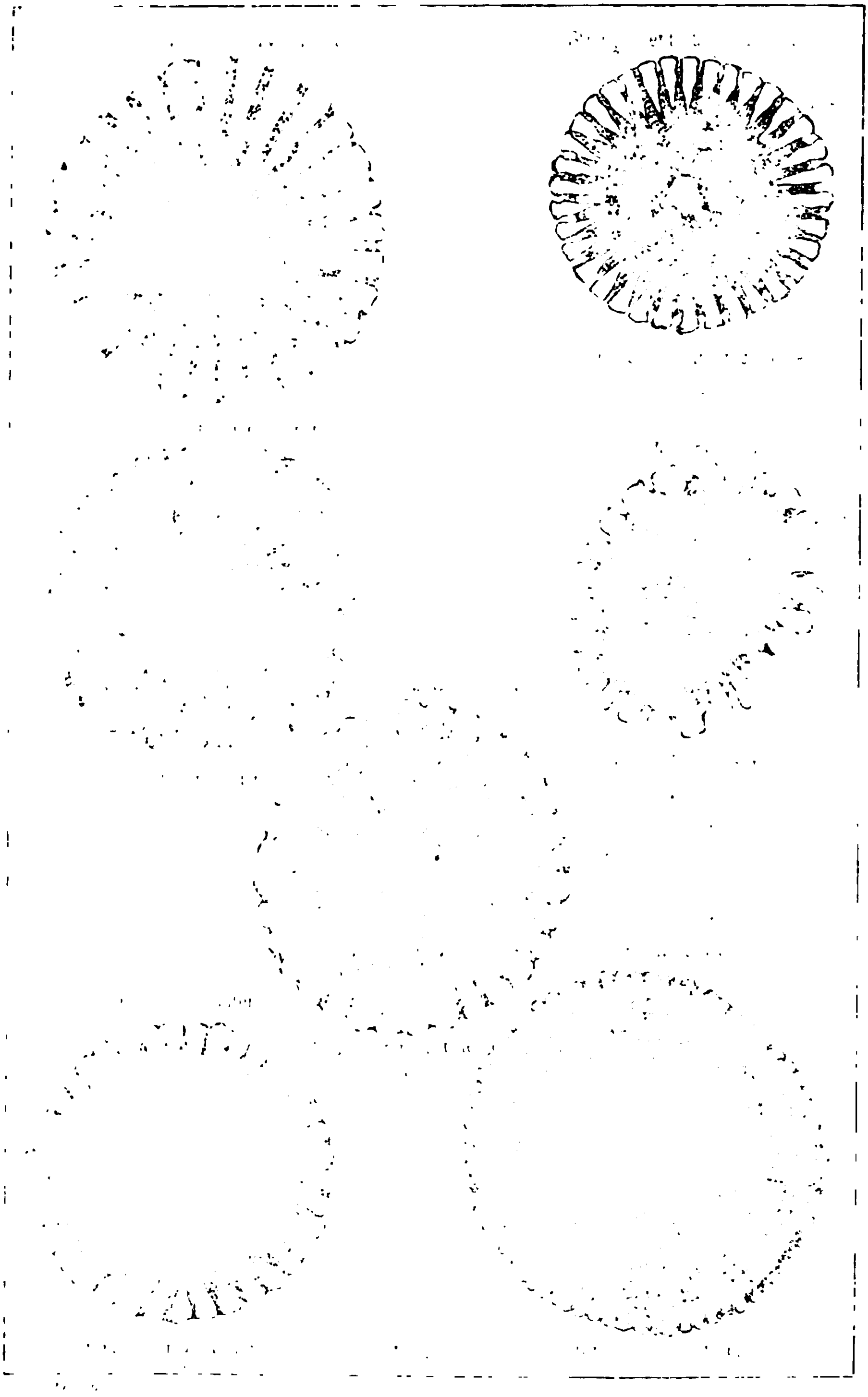
THE effect which an injury to the spine of a sea-urchin has in changing its structure, as well as the nature of that structure, exhibited in transparent sections, was first pointed out by Dr. Carpenter in his "Report on the Microscopic Structure of Shells," read before the British Association in 1847. He there figures and describes a transverse section of the spine of *Echinus lucunter*,* in a portion of which the solid pillars, which form the regular circles in most spines, have disappeared, and been replaced by a network, though in the layers produced afterwards the solid pillars return. Subsequently the late Professor Quekett in his "Histological Catalogue," described a somewhat similar effect in a spine of the same genus, and in the number of the "Monthly Microscopical Journal" for May, 1870, there is a paper read by Dr. Carpenter before the Royal Microscopical Society on the structure of Echinus spines, in which he alludes again to the same subject. He infers from the examination of the spines of *Echinus* (*Heterocentrotus*), *trigonarius* and *Acrocladia* (*Heterocentrotus*) *mammillata*, that the new growth proceeds mainly, if not exclusively, from the exterior layers of the spine, since in longitudinal sections a distinct continuation is traceable between the primary and the restored parts towards the periphery, whilst there is a complete interruption between the calcareous network of which the central portion of the spine is composed, along the line of fracture.

In the course of the writer's investigations into the structure of the spines of Echini, examples of the effects of injuries to these organs have from time to time presented themselves, some of which he has already described;† in the present communication details of a few more are presented.

It is still an open question whether there are settled generic or specific characters derivable from the structure of the spines; the writer has already (*loc. cit.*) expressed his conviction in the affirmative, at least as regards generic distinctions, and believes that further investigation will prove that when a group of organisms—be it genus, family, or order, in either animal or vegetable kingdom—exhibits close affinities amongst its members, that histological differences will be found to be not only sufficiently strongly marked to be recognisable, but also sufficiently constant to be used in identification. As illustrations of this, it may suffice to allude to the investigations of Professor M'Nab on the leaves of *Pinus*, which go to show that each species can be recognised by its leaf-structure,

* Judging by the specific name, this is *Echinometra lucunter*, though the writer has never seen an *Echinometra* with any approach to the structure figured by Dr. Carpenter, although he has examined a considerable number.

† Transactions of the Royal Irish Academy, volume XXV.



and to the well known fact that spicules of Gorgonian corals are at least generically characteristic.

Taking this view of the matter, it becomes at once important to determine the results of injuries to the spines, in order, in the first instance, to prevent mistakes being made in the interpretation of the structure, and also because appearances may be produced thereby which throw light either on the development of the spines themselves, or on the affinities indicated by them.

The spines of the following species have been examined:— *Stomopneustes variolaris*, *Echinometra lucunter*, *Strongylocentrotus lividus*, and *Echinus esculentus*. The result in every case is the reduction in quantity of the solid structures, and a corresponding increase in the amount of the reticulated tissue; but the writer's observations as to the new growth do not quite accord with those of Dr. Carpenter, for in most, if not all of his specimens, the central network is more continuous throughout than the marginal, and even in those spines which have been twice fractured and repaired, it is not uncommon to see the new and old tissue running into one another along the axial part, whilst at the margin there is a sharp line of demarcation, and a total change in the character of the network. This is specially noticeable in the case of *S. lividus* (plate V., fig. 1), and *E. esculentus* (plate V., fig. 3), whose spines consist of a small central disc of network sending out a number of radii between which are interposed a series of wedge-shaped solid pieces, which in quantity greatly exceed the reticulated tissue. When these spines are repaired, there is a large quantity of network produced, which, sometimes corresponding exactly with the central portion, merely increases it in area, and sends out thicker "spokes," thus bringing the two kinds of structure (solid and reticulated), nearly to an equality in point of amount, but not unfrequently is distinguished from it by the much smaller size of its interspaces, in which case it encroaches more or less on the solid wedges, and almost entirely replacing them, reduces them to the condition of small segments placed round the circumference of the spine. Curious, almost mimetic, forms are sometimes produced in this way; thus in a specimen of *S. lividus* (plate V., fig. 2), the central portion of the spine is occupied by a hollow, which has evidently existed for some time, as it is surrounded by an attempt at a continuous ring, somewhat like the "foraminated ring" of Diadematidæ, around this there is the usual central network, but about double its ordinary amount, and sending out a number of rays, which instead of being nearly the same width throughout, are much wider centrally than peripherally, and cause the solid wedges to taper rapidly towards the middle, conferring altogether on the spine an appearance not unlike that found in the fusiform spines of *Centrostephanus*, or in those of *Echinothrix turcarum*. The structure of the "striate" spines of *Asthenosoma varium* (Diadematidæ) is still more closely imitated by a spine of *E. esculentus* (plate V., fig. 4), in which the central network has become hypertrophied to a large ex-

tent, and the solid pieces are represented only by shortly triangular wedges separated from one another by considerable intervals, and sending in towards the centre thin tortuous stalks which soon become lost in the abundant network.

The alterations produced by injury to the spines of *Echinometra lucunter* are very remarkable. The typical structure in this genus (plate V., fig. 5) consists of the usual central network, from which a number of rays proceed somewhat after the fashion of *E. esculentus*, but differing in expanding at intervals into larger areas in which the meshes of the network become wider, and which are joined by transverse bars usually increasing in number from without inwards. Interposed between these rays are a number of solid pieces somewhat quadrate in shape with rounded corners and marked by faint striæ placed round an excentric dot.* The network of the rays, however, differs from that in the centre in this respect, that whilst in the latter it is composed of *solid bars* anastomosing with one another, in the former it consists of *interlacing tubes* excavated in the solid calcification.

When these spines receive an injury and are repaired the new growth is laid down in the form of a number of rays with parallel or very slightly divergent sides running from the centre towards the periphery and joined by a regular series of transverse tubes passing across the solid spokes which take the form of long bars about as wide as the reticulated rays. I have little doubt that this gives the key to a form of *Echinometra* with apparently dimorphic spines, which seemingly on this account was described as a distinct species under the name *Echinometra acufera*. In it, besides the usual conical spines, which are much more numerous and have the typical structure, there are some spines which are club-shaped and end in short points. In their internal structure (plate V., fig. 6) they have the rays of network, which start as usual from the centre, gradually expanding for about two-thirds of their length, then contracting and ending at the circumference in narrow apices, between which are placed the expanded ends of the solid pieces whose narrow stalks, running in towards the centre, are traversed at intervals by transverse tubes which unite the reticulated rays. The structure of this spine is thus very diverse from the normal type, and furnishes us with strong indications of an affinity to *Parasalenia gratiosa*, another genus belonging to the same family (Echinometridæ), but linked to the family Arbaciidæ, not only in the structure of its spines but also in the arrangement of its abactinal system.

The alterations effected in the spine-structure of *Stomopneustes variolaris* (plate V., fig. 7,) so far as the writer has yet seen, are of less interest. The normal structure of the spine in this species consists of a series of solid spokes radiating from the central net-

* There is a very good figure of the spine structure of *E. lucunter* in Dr. Carpenter's "The Microscope and its Revelations."

work and expanding at intervals into a number of pillars, semicircular in section and forming externally the "costæ" of the surface of the spine, which has throughout its whole substance a close irregular network of tubes. The repaired parts exhibit simply a mass of the latter without any appearance of solid pillars, though the writer is inclined to believe that this appearance may be due to the interpenetration of the pillars by the tubes to such an extent as to destroy their solid condition, since in the row of solid pieces forming the external ribs, the form of the latter is retained, though their substance is so filled with the ramifying tubuli that scarcely a trace of its original constitution is retained. The effect seems to be similar to what obtains in *Heterocentrotus* which *Stomopneustes* strongly resembles in its plan of structure, and it is quite possible that spines which resemble each other in their primary arrangement may in the process of repair exhibit parallel modifications, a supposition which if verified would point to fundamental differences in the arrangement of the protoplasm—if the spines be the result of protoplasmic action, as seems probable—which may give us the key to the true significance of spine-structure.

On the Rheea Fibre and its Mechanical Treatment. By J. ANGELO FAHIE.

[Read Monday Evening, November 15, 1875.]

I HAVE much pleasure in introducing to the notice of the Society, this evening, the consideration of the Rheea Fibre, and its mechanical treatment, together with its uses in the manufacture of textile fabrics and its application to other useful purposes.

My object is simply to lay before you, as briefly as possible, a statement of the present position of this useful fibre, to the development and utilization of which so much active attention is now being directed, both by the Government and private enterprise in England. I also wish to explain the wide range of uses to which the fibre may be applied, the various mechanical appliances which have been in use for its preparation, and the measures now proposed by Government to encourage its extensive use in textile manufactures, and to discover the best method or process for its preparation for the market.

Rheea, it must be known, is a vegetable fibre which textile manufacturers are endeavouring to bring into use as a substitute for, or, at least, as an auxiliary to flax, hemp, jute, cotton, and wool; but the great obstacle which stands in the way of its practical utilization is the difficulty of operating mechanically on the separation of the fibre from the stems and bark of the plant.

Rheea (*Boehmeria nivea*), natural order, Urticaceæ, indigenous to India, grows freely in the plains at very low elevations. It is known by the native names, Ramie, amongst the Malays, and

Chuma, in China. In habit it is a shrub varying in height from five to eight feet, the branches are covered with short, spreading hairs, the leaves are long, with serrate margins terminating suddenly in a very fine point. The range of growth of the plant is very extensive—it is found in China, Japan, the Philippine Islands, and Siam; it has been introduced to Mexico, the Southern States, and also experimentally into the south of France, as well as Algeria. Even in England its cultivation has been attempted; good specimens exist in the Botanical Gardens of London, and some of it has been raised in the gardens of His Grace the Duke of Wellington, at Strathfieldsay.

The plant is mainly propagated by root cuttings, it requires a good deal of moisture for its full development, and appears to thrive best in the shade.

The history of the Rheea trade only dates from the beginning of the present century, when the attention of the East India Company was first directed towards the plant as producing a fibre which might be utilized extensively and advantageously in the manufacture of textile goods. Little active measures were, however, then taken in connexion with the fibre until about twenty-five years ago, when public attention was again directed to the subject by the discovery of the plant growing in a wild state in Assam, and large quantities were imported to England, and operated upon by enterprising manufacturers. Owing, however, to its high price, and the difficulty of operating mechanically on the stems, the fibre did not command a ready sale, its commercial value dwindled, and the matter was almost disregarded, when in 1860 the Government of India, being fully convinced of the excellent qualities of the fibre, and sensible of its great value as an article of export, if only a ready separation could be effected, offered a premium for the best and second best machines which would extract the fibre from the stem at a cost not exceeding £15 a ton, which fibre would be worth £50 per ton in the market.

These offers induced thirty-two competitors to enter their names, but at the last moment only one of them appeared in the field, and this one upon being tested failed to fulfil all the conditions of the competition. The inventor was, however, awarded a donation of £1,500 in recognition of his ingenuity and enterprise. I exhibit drawings of this machine, which, although it did not come up to the mark at the Saharumpore trial, is a remarkable specimen of ingenious machinery.

Any gentleman present, interested in the subject, is at liberty to examine these drawings, and also the detailed description which accompanies them. The machine was designed to separate the fibre from the stem, and clean it fit for spinning, at a single operation; but the cost of production was considerably over £15 a ton, and the fibre, when valued, was only worth £28 per ton.

This competition took place in 1872, and so far as introducing the fibre into commerce, the action of the Indian Government failed. It, however, created a greater interest in the subject, and developed

a more anxious desire on the part of inventors and manufacturers generally to discover some successful method for its treatment and utilization.

Now, as I have already observed, the great obstacle which stands at the root of the whole trade in Rheea fibre is the difficulty of finding suitable machinery, which will rapidly extract the fibre from the stems of the plant in a clean state, fit for combing and dressing; and the principal reason why it is so difficult to manipulate Rheea, in contrast with other vegetable fibres, is owing to the large amount of moisture and gum which it contains, and the difficulty of extracting this gum by means of retting.

In its general character—for instance, in length, thickness, and woody nature of the stems—the Rheea appears to resemble hemp, so that it might be supposed that the same machinery and processes which are suitable for the one ought also be suitable for the other. This would probably be the case but for the difference that the Rheea stems are much more succulent than hemp. The Rheea stems lose on drying about 80 per cent. of moisture, while hemp and flax lose only about 50 per cent. Now, it appears that the more moisture, the more extractive matter is contained in a plant, and therefore the more gummy and glutinous constituents Thus, flax and hemp contain gum to the extent of 25 per cent., while the Rheea, which contains a much larger proportion of moisture, contains also a larger per-centage of gum, which is the great obstacle in the way of its successful treatment. This gum is affected when exposed to the air, it coagulates, becomes insoluble in water, it sometimes covers the rollers of machinery with a resinous coating, and sometimes it becomes thickened, binding all the fibrous threads together and destroying them.

In the case of flax and hemp the method usually adopted for the removal or destruction of this gum, consists in retting, during the process of which the gum is destroyed by fermentation. Now, the larger the proportion of moisture and gum in a plant, the more difficult it is found to control the process of fermentation in such a manner as that the fibre shall not be injured by over-retting; therefore, it will be readily perceived that the large quantity of gum in Rheea makes the retting a difficult operation. Some manufacturers assert that retting is inapplicable to Rheea, owing to the fact that thick and slender stems are invariably found together, also the top part of the stem is always much more tender than the lower part, consequently there is always danger of a large proportion of stems being over-retted, whilst the thicker sticks will hardly have been attacked by the fermentation. Although difficult to regulate, retting must not be considered impossible. The operation will have to be conducted very carefully, the stems must be separated according to their length, thickness, and dryness, and the slender portion must not be steeped so long as the thicker ends of the sticks.

I will now proceed to consider the commercial aspect of the

fibre, and compare it with other fibres with which it may compete; and also the probability of its yet forming the basis of a new textile industry, so soon as a suitable method of preparing it has been discovered.

As regards its physical properties Rheea takes a high place; it is, in fact, said to be pre-eminent amongst fibres for its strength and lustre.

It is considerably stronger than either flax or hemp, and it excels almost all known fibres in its power of resistance to the influence of moisture. Although strong and resisting, the fibres are as fine, if not finer than those of flax, some being as fine as $\frac{1}{5000}$ part of an inch in diameter, and equal to the finest of fibres, that of the pine-apple. In gloss and fineness it resembles silk—jute is the only fibre that can compare with it in this respect—and, owing to its remarkably hairy character, it resembles wool.

Rheea has been tried more or less successfully as a substitute for or in connexion with cotton, hemp, flax, and silk.

Amongst the fibres which at present enter into textile manufactures, flax is perhaps the one which possesses the most extended range of applications. From the roughest canvas to the finest lace is made of flax; yet it appears the range of Rheea is greater still, owing principally to its fineness, strength, and lustre, and also to the intermediate position it holds between the vegetable and animal fibres.

During the American war it was tried with cotton, and the fabrics made from the mixture, as compared with those of the pure cotton, are said to have gained in strength, and also to have acquired a considerable amount of gloss, rendering them more similar to linen fabrics.

There seems to be a fair probability of Rheea becoming a formidable rival to flax, especially to the finer varieties, and if it could be worked up on flax machinery, its development in this line would be immensely facilitated.

Its application as a substitute for wool has attracted considerable attention. The hairy nature of its fibre specially favours its use in this direction.

A great number of experiments have been tried with regard to the suitability of Rheea for being used as a substitute for silk, or even as an admixture with it. The glossiness of the fibre naturally suggested this application. It has, however, in this branch of industry, a formidable rival in the much cheaper jute now so largely used in connexion with the manufacture of fine textile stuffs.

In connexion with hemp, the Rheea fibre has been used to some extent, especially in the making of nets, fishing lines, ships' rigging, and other purposes for which strength, lightness, and power of resisting moisture are essential.

It has also been found valuable in the manufacture of paper, as it gives it greater tenacity and strength than has hitherto been obtained.

Thus, it will be seen that Rheea, in virtue of its qualities, has a wide range of affinity with other fibres; and, from the various uses in which it may be employed, its application covers a wide field indeed. Therefore, if the introduction of Rheea depended on its physical properties, there is scarcely another fibre which would have a better chance of success; but, as I have already intimated, against this success stands the technical difficulty of its manipulation in a cheap and effective manner.

Let us now consider the mechanical treatment of the plant. Hitherto the usual manner of extracting the fibre from the stem has been performed by hand labour alone.

The natives of India and China perform the operation in the following manner:—They take the individual stems, split them longitudinally with knives, then tear down one side, then the other, and after carrying on this operation for a time, they take a bundle of the fibres, place them on their knees, and scrape them carefully until they are fit for spinning. The preparation of the fibre in this manner is, of course, slow, tedious, and expensive, and renders its first cost far too high to allow it to enter largely into commerce.

It is to the discovery of an improved process on this primitive mode of preparation that the present action of the Government is directed, as well as the lively attention of inventors and manufacturers interested in the development of the trade.

Several machines have been invented within the last few years, all claiming to deal with the fibre in a sufficient and satisfactory manner. It must be borne in mind that the obstacles which stand in the way of treating this fibre mechanically, are the large amount of gummy matter which it contains and the difficulty of extracting this substance by the process of retting.

To overcome this difficulty a number of chemical processes have been tried. For instance: a Belgian uses a patent system of retting in warm water, in which he mixes some alkaline sulphurets, which, he states, never allows the retting to proceed to the extent of injuring the fibre. But chemical processes add considerably to the cost price of the fibre, and are consequently regarded as inapplicable towards making the material a useful and general article of commerce.

What is absolutely required is a machine which will extract the fibre from the stem and turn it out in a clean and cheap manner at a single operation, and the machines that have as yet been brought out are, it appears, incapable of solving this problem.

An elaborate machine has been introduced lately from San Francisco, the inventor of which claims that he can, at a single operation, break up the sticks, extract the fibre, destroy the gummy matter, and turn out the fibre fit for spinning; but this machine, I believe, has not yet had a fair chance of proving its practical value.

In several parts of England the Rheea plant is treated and employed to some extent in textile manufactures, especially in Wakefield, where, I am informed, considerable quantities of the fibre

are used by two enterprising manufacturing firms, who operate on the plant in all its stages, from the extracting of the fibre, in the first instance, to the weaving of the beautiful fabrics, samples of which you see on the table.

Yet, notwithstanding the long period that this fibre has been before the notice of manufacturers, and the efforts that have been made by the Indian Government to encourage its use, the subject appears to be still in its infancy, and does not seem to have advanced much beyond the experimental stage.

Therefore it is that this important branch of industry has now for the third time since its first introduction, become the subject of official action.

A series of trials have been arranged to come off in England, either this month or next, with the object of ascertaining the best methods for the preparation of Rheea, by mechanical, chemical, or other means. To carry out these experiments, the necessary space, motive-power, water, and other facilities will be supplied by the Government. The utmost care will be taken to secure reliable results, and to make public the whole of the details connected with the experiments. The exact date and place of the trial are not yet announced.

The Government has not yet deemed it advisable to offer a prize at this competition, because it is considered that the great prize would be the success of one or more machines which might come to the front during the trials.

The points to be considered are—first, the cost of the necessary machinery; secondly, the expense and simplicity of manipulation; and thirdly, the yield of clean fibre per ton of stems.

Every latitude will, it is promised, be allowed to inventors, and every machine will doubtless have a fair trial.

Such, then, is the present position of the Rheea industry, and the efforts made for its development. In the foregoing observations I have endeavoured to notice the subject, with all its surroundings, as fully as the limits of a paper read before this Society would permit; and, in conclusion, I would remind you how anxiously the attention of textile manufacturers and others interested should be directed to the development and progress of this useful fibre, which, from the wide field of its applications, would be productive of such valuable results, and which would form so beneficial an adjunct to that branch of industry, the manufacture of textile fabrics, which, in its various departments, affords employment to a greater number and a greater variety of individuals, than any other branch of human occupation.

To the admirable report lately issued by Dr. Forbes Watson, of the India Museum, I am indebted for a considerable portion of the information contained in this paper; and to that gentleman I am also indebted for the numerous specimens of the fibre in its various stages, and the manufactured fabrics which I have the pleasure of exhibiting before the Society this evening.

XIX.—*On the Pictorial Delineation of Animals in rapid motion, with Illustrations.* By M. ANGELO HAYES, R.H.A., M.R.D.S., and Member of the Institute of Painters in Water Colours, London.

[Read, Monday Evening, the 20th November, 1876.]

THE subject upon which I am about to address you this evening has always been a difficulty to artists, because they have to convey to the mind an idea that the animals they depict are in rapid action, while the representation they give is at the same time perfectly still, and that which in nature can scarcely be followed by the eye, is in pictures regarded at leisure, as an unchanging record.

I have heard that the late Archbishop Whately said, with reference to painting a horse galloping, that a man might as well try to represent a windmill in motion.

It often happens that in order to appear true, objects have to be represented, to some extent, untruly by artists, who have to represent things as they *seem*, and not as they really *are*. For instance, there is the representation of wheels in motion, as when a carriage is to be depicted with the horses attached going as if at a quick pace; the revolution of the spokes is so rapid that they become almost invisible to the eye, showing as faint indications of a multitude of spokes. In former times, and especially in the sporting prints of the last century, the wheel of a carriage intended to be as if in motion was represented exactly the same as if the vehicle was stationary. That was representing the thing as it is. The artist knew the wheel had a dozen or so of spokes; and so, no matter how rapidly the carriage in the pictures was supposed to be dragged by the horses, the wheel was represented with its accustomed number of spokes. Early art, and the pictorial attempts of rude nations take always this literal view of things; it is when the eye becomes more cultured, and observation more discriminating, that the *appearance* of the object is taken into consideration. Hence, generally, the superiority in naturalness and truth to nature of modern over ancient art. I have heard that a photograph of a rapidly revolving wheel was once obtained. It was done in a dark room, on a highly sensitized plate, and, instead of taking off the cap of the lense, the wheel was lit instantaneously by a spark of electricity. When the image was developed, it was found that it looked almost the same as if the wheel had been taken at rest instead of revolving.

In representing animals at full gallop, a conventional method has hitherto prevailed, and must, indeed, to some extent be adopted by artists; but, still, natural truth and probability must be kept in view, and the appearance which the animal presents to the eye when galloping must be the artist's task to represent to the best

of his ability. To represent it exactly is impossible, and, if possible, would probably be undesirable.

In old art the horse at a gallop was invariably depicted with his hind hoofs planted on the ground and the fore legs raised high in the air, generally outstretched on a line with his body; but sometimes the legs were depicted as bent at the knees. In our Irish National Gallery there is a bas-relief from Nineveh, in which the horses drawing the chariot of an Assyrian hero are thus depicted; and similar representations of galloping horses are on the walls of ancient Egyptian buildings. In Guido's "Aurora," the legs of the piebald horses are represented in the same position. In all Snyders' pictures this is the attitude in which he places horses, dogs, wild boars, &c.; and in the hunting and sporting prints and pictures of the last century, this is the invariable representation of the hunter or the racer at full gallop. Thus, it will be seen that there is high antiquity in favour of such a representation, of which Fig. 1 is an exemplification.

Fig. 1.

From an OLD PRINT.

A remarkable exception is, however, to be seen in the remains of Greek art which have come down to us. The figures of animals on the Metopes of the Parthenon, the various sculptured figures

on the frizes, and in the representations of the battle of the Centaurs and the Lapithæ—amongst the numerous horses, not one is in the usual conventional position I have described. The Greeks were keen observers of nature. In art they seem to have left us nothing to discover, and nothing to excel. All the horses in these sculptured remains have the hind legs well under the haunches, the fore legs at the same time extended and thrown out, which is very much the natural action. Fig. 2 is from one of the Parthenon frizes.

Fig. 2.

From the EASTERN FRIZE of the PARTHENON.

In the early part of the present century an artist named Henry Alken became remarkable for his sporting sketches and pictures. He had great talent, and put extraordinary life and spirit into his works; especially was he successful in delineating horses in action, whether trotting, leaping, or galloping. His hunting and racing pictures—in which he excelled all his competitors—were remarkable in this respect, that he introduced a new method of delineating the action of a horse at the gallop. All the legs were off the ground—which is not untrue—but the hind legs were stretched to the fullest extent behind the animal, and the fore legs equally extended in front, and that never happens.

Fig. 3.

After HENRY ALKEN.

Fig. 3 is copied from one of his sketches, and is in fact the method which artists now almost invariably adopt. Fig. 4 shows a horse standing still, and is drawn to the same scale as Fig. 3.

Fig. 4.

This conveyed the idea to the mind of the spectator, of great speed, and was in many respects an improvement on the old method. In my early career as an artist I was greatly impressed by the vigour and spirit of his admirable sketches; and it never occurred to my mind that there was anything in this delineation of the gallop in the slightest degree departing from natural truth; and I dare say a similar idea is entertained by the great majority of my hearers. You have come to regard it—as I did—in the light of a perfectly accurate version of the horse's action; and, most likely, would think any other method false and untrue, so much does the mind govern the eye. Nevertheless, I have no doubt that it does not represent the horse's action; and before the conclusion of my paper, I hope to show you that it not only is a position which the horse (or any other animal) never is in when galloping, but is a position which he could by no possibility ever be in.

I was some years practising my profession before I became aware that there was a discrepancy in the appearance which horses presented when galloping as compared with their representation in pictures. Observing horses in the Phœnix Park, at reviews and field days—especially when charging at full speed—and observing them go by on race-courses, I was conscious of a great difference in the effect. I found it difficult to note in what the difference consisted, so rapid is the action of the horse; but on the whole, the effect to my eye was, as if the legs were rather doubled up than extended, and I noticed this more particularly as regarded the front legs. I was also struck with the little difference which was apparent between the height of a horse's back from the ground when walking or when galloping; but in pictures the difference was very marked indeed—the galloping animal being represented as nearly one-third less in height; in fact, this extreme difference became grotesque to me. Fig. 3 and Fig. 4, if compared, will exemplify this difference—and, I think, show conclusively the impossibility of the animal as depicted in Fig. 3 supporting his body on his legs when so close to the ground. I also observed, as any of my audience can verify for themselves, that a body of cavalry, in wheeling—where the men on the inner flank walk their horses, the men in the middle trotting, and the men on the outer flank galloping—that there is no perceptible deflection in the horizontal line of their heads. This brought me to considering how the animal was to be supposed to move his legs when his body was—in pictures—represented so close to the ground; for, I argued, the animal must support himself on his legs some time, and how is he to do it? And if, while the hind legs are fully extended behind him, and the fore legs out before him, what is the animal to be supposed to do with his fore legs, while he brings the hind legs in under his body, as he must. In reality, I knew he did not keep them out in front like a lance at the charge; for, in truth, I was unable to catch the fully outstretched action of the fore legs with my eye at all. I knew it

must be thrust out, but I only could observe a sort of bent action of the fore legs, as if rather doubled in than straight out. But my difficulty reached its height on one occasion in the Park when, driving through, I observed, a little in front of me on the sward, a gentleman galloping his horse; the sun was setting at my back, and the light shone on the surface of the horse's four shoes at every bound forward. I saw the four shoes distinctly at the same instant cut out in vivid relief by the flash of the sun; and I knew I could only see this if all four were turned towards me at the same angle and at the same moment. Thus, if the received method of delineating the gallop was correct, this could not occur; *ergo*, I argued, it must be incorrect.*

This set me upon endeavouring to analyze the precise movement of the horse in full gallop; to ascertain, if possible, the *modus operandi* of the animal's progress; but I found it more difficult than I expected, owing to the rapidity with which he rushes past, and also the still more rapid action of the legs. The result of careful observation convinced me, however, that when the fore legs are thrown out in front the hind legs are brought in under his haunches, and when the hind legs are extended backward, then the front legs are drawn in under the shoulder; or, more correctly, the shoulder, from the impetus of the animal's body, becomes thrown forward over the fore legs. By fixing one's eye upon the near hind and the near fore leg, it will be seen that the legs go almost together, as if united by a connecting cord or strap, alternately advancing and touching the ground as they appear to recede under the animal. This will be best observed in the canter, which is a movement only differing from the gallop in the rapidity with which the feet touch the ground at the latter pace. The legs upon the off side are not moved simultaneously with the near ones; one fore leg is always a little in advance of the other; and the same, of course, holds with the hind legs. Thus, the animal advances by a kind of alternate movement of the legs on each side, but so slight is the interval that the whole four legs appear to go almost together, back and forward, each hoof striking the ground in quick succession, one after the other, making four distinct and rapid sounds to the ear.†

Professor Marey, of Paris, has published a little physiological treatise under the title of "La Machine Animale," in which he takes great pains to explain the principles of locomotion, both of men and quadrupeds, and he particularly instances the different

* Messrs. Robinson and Sons, Grafton-street, Dublin, have published a large photograph taken from a figure in a picture just completed by Mr. M. Angelo Hayes, painted by order of Earl Spencer. It represents, as nearly as possible, the position of the horse above described.

† Here the lecturer gave an exact imitation, with his fingers on the table, of the sound of a horse's feet in the canter, gradually increasing in rapidity, as the canter was supposed to break into a gallop.

paces of the horse; but I cannot agree with his statement that the gallop is most commonly in three time, meaning that the impact of but *three* sounds of the feet striking the ground is heard; but the Professor admits that the full gallop is really a movement in four time. He says:—"Although the fore feet hit the ground with a fair interval, the hind feet hit it *nearly* simultaneously; the time of complete suspension is extremely short." He used an ingenious instrument to register the footfalls, which consisted of elastic tubes fastened to each foot of the horse, by means of which movement was communicated to the levers of a recording instrument held in the hand of the rider. The peculiar movement which children adopt when playing at horses is also alluded to, as exemplifying the gallop of the horse. Children then move both legs almost simultaneously, keeping the right leg in front, the left foot touches the ground first, as the spring forward is made, but the right leg is ever kept in front. This is almost exactly what the horse does with the near hind and the near fore leg in the gallop.

Fig. 5.

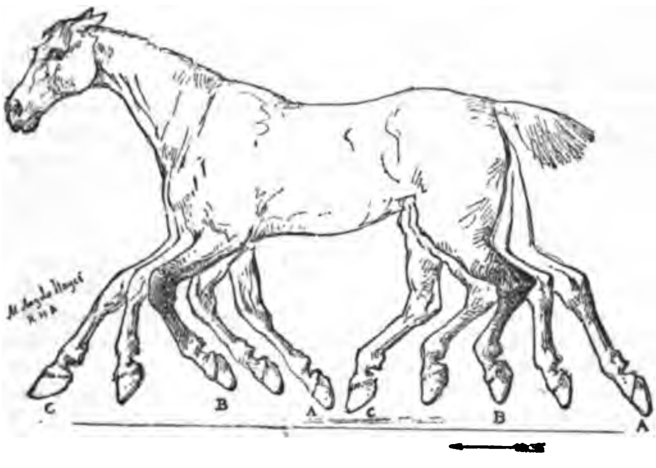
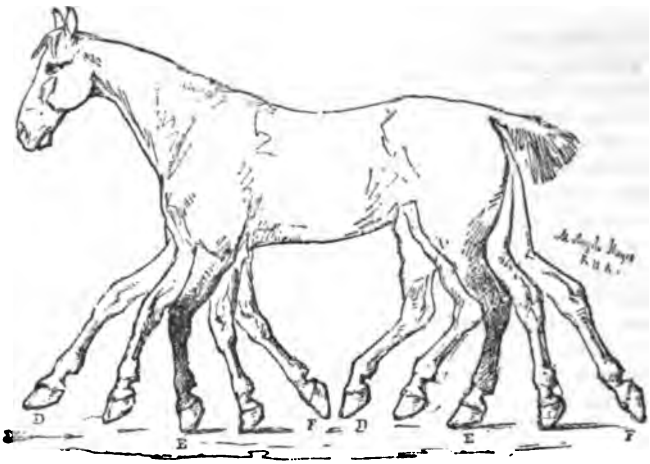


Fig. 5 shows the action by which the near side legs are lifted forward, A B C, and fig. 6 shows the way in which the same legs support his body as it is impelled forward over the legs, D E F.

These two diagrams prove that in the gallop it would be almost impossible for a horse to raise the knee and hoof to a horizontal line, as we so often see them represented in pictures; and what a loss of power and time it would occasion to the animal, if he did so raise it.

[Fig. 6

Fig. 6.

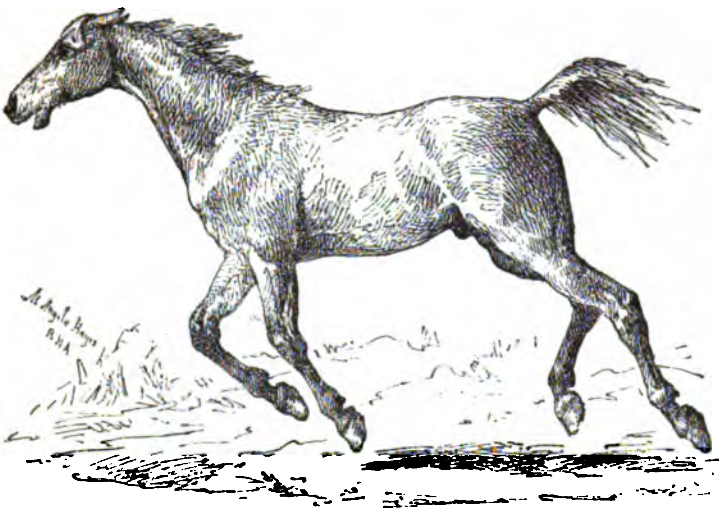


The great propelling power is in the hind legs; the fore legs, of course, assist, but their function is more to support the weight of the body. The hind legs are raised forward from the ground a little sooner than the fore legs, but before they have time to reach them the fore legs are also raised forward; but so minute is the interval that, to the eye (as I have before observed) the legs appear to move almost simultaneously; and thus by successive bounds the horse advances, and so do all quadrupeds—cattle, dogs, hares, &c., the same mode of progression is common to all. There may be a slight variation in the pace of different horses, caused by accidental formation, a greater length of leg, or a shortness of the body, for I am aware that occasionally a horse will strike with the toe of the hind hoof the heel of the front one; but it is infrequent, and arises probably from a length of leg, and from the front hoof not being carried forward with sufficient quickness. Fig. 7 shows the track of a horse's hoofs in soft ground when galloping. The hind hoofs are marked H; and, it will be seen, are carried well in advance of where the front hoofs had been placed.

Fig. 7.

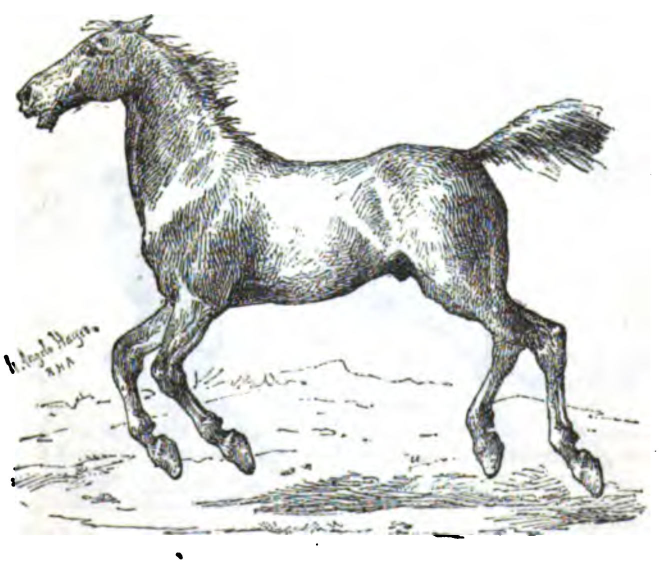
The average length of a horse's stride, measuring from hind hoofs to hind hoofs, is about twelve or fourteen feet, but varies very much. "Harkaway" was said to have made a stride of seventeen feet.

Fig. 8.



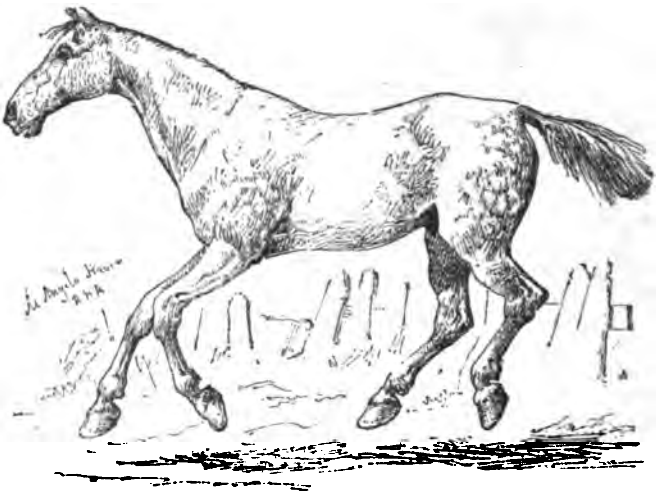
Figs. 8, 9, 10, and 11 are intended to exemplify the different positions of the horse in his stride, from the instant of lifting the legs from the ground to the position when they are most advanced in front of the animal.

Fig. 9.



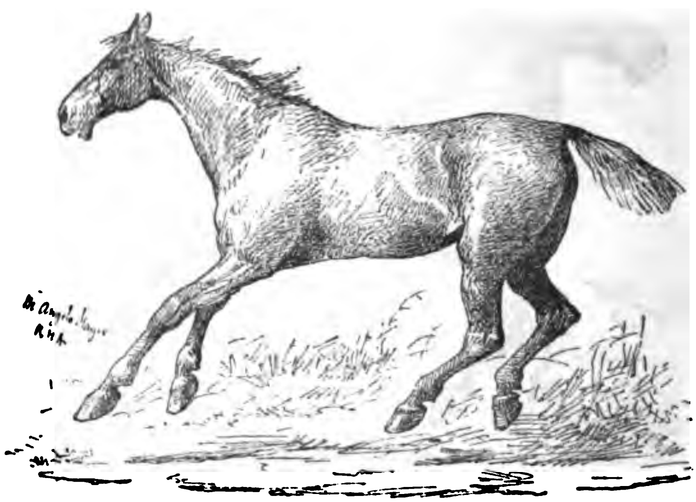
They have been drawn more with the object of showing the exact movement of the gallop than as examples of the proper way to represent it; but, with slight modifications, they exhibit the true positions in which the horse at the gallop ought to be delineated.

Fig. 10.



No doubt to most of my audience these drawings will seem more or less grotesque.

Fig. 11.



The eye has become so accustomed to the usual representation, as shown in Fig. 3 (page 258), that any deviation from it will, as a matter of course, be deemed wrong. So much does the mind influence the eye, that we get accustomed to forms which are believed to be correct; and most persons are content to take things for granted. Those who use their own powers of observation, and examine for themselves, are a very small minority. Custom and fashion decide most things. We all know how we used to admire the magnificent rotundity of ladies' forms some half dozen years ago, and how absurd we would have then thought anything else; but now we are all familiarized with a totally different presentation, and are called upon to admire what Le Hunt used to call the insipidity and lanky form of Canova's Venus. "A belle of the drawing-room" would now appear absurdly grotesque in the bell-shaped garments of a few years back. I have very little doubt that, when H. Alken first began to sketch horses in that outstretched way which is now so familiar to us, and accepted so trustfully, it may have been then thought that his drawings were not natural. It was an innovation; and I am sure those used to the form shown in Fig. 1 thought Alken's representations grotesque and unnatural.

Where a number of horses, as if galloping, are in pictures, they are all represented in precisely the same attitude. All the legs outstretched at the same moment, and in exactly the same attitude; the footfalls, of course, would in such a case fall on the ground in as exact cadence as soldiers march. One never sees *that* in nature. At a review, when the cavalry defile past the general at a canter, the band playing "Bonny Dundee," although every effort is made to try and get the horses to "canter in time," it cannot be done; there is always more or less of irregularity of pace. In a charge of cavalry this irregularity is most marked as they come headlong, thundering up; all the front legs seem bent or gathered under, and no two horses are in the same position; but in pictures of a charge the regularity with which the front legs are all stretched out is beautiful. In the last Royal Academy Exhibition there was a picture representing the return from the Balaklava charge. Now, if ever there was a time when horses were madly galloped out of that hail of death, it was then; but still the representation showed every horse in the very same stride, as if the band on the flank was playing "Bonny Dundee," and the hoofs marked the time. Now, I think that grotesque and absurd; and I would consider any change, or any theory which would upset such an arrangement, most desirable, and worthy of consideration. I do not claim that I have hit on the only true method; I have but indicated the way; I trust that other minds will eliminate a more just representation, and that in helping to this, the hints I have thrown out may be found useful.

The effect to the eye is what artists have to study and represent; and in the gallop the legs appear, so far as the eye can follow their

rapid movements, to be rather bent in or curved than anything else. If one reasons upon this, it must be so; because, the front legs, when thrown out or extended fully in front, are so instantaneous in their action as to be all but invisible in that position; but the leg is bent in advancing to this, and also in drawing it in again—or, rather, as the body is projected over the leg. The bent action is therefore impressed on the eye, almost as three to one of the other. It follows, I fear, that the artistic representation is more what the mind knows, must be the actual fact, than the appearance presented, and is but a mere barbaric and conventional representation. On the other hand, if an artist attempts to deviate from the conventional cut-and-dry, he will be sneered at, and possibly abused; therefore, what is he to do?

Several foreign artists have shown in their representations of horses, a manifest endeavour to give a more just rendering of the gallop than English artists have at all attempted. The works of H. Bellanger and Victor Adam contain many examples of an approach to a better form. Horace Vernet's great painting of "La Smala" also evinces the endeavour to depart from the usual absurd conventional method. There was a painting by a German artist in the International Exhibition at Earlsfort-terrace, in 1866, of a steeplechase, in which a horse daringly foreshortened was rising to a fence, coming right towards the spectator, which was excellent; and a grey horse coming close after had the front legs much as I have shown in my figures, and the hind legs were very nearly correct. Landseer was rather chary of representing animals in motion. I only can recall two—both very early works, and both in the usual conventional method.

I had, in the Exhibition of the Royal Hibernian Academy, a few years ago, a picture representing a runaway horse—his rider as if just shot. In it I tried to represent the action of the legs more in accordance with what I saw in nature; but at the time I had not satisfied myself as to the true theory of the horse's movement. I believe my picture was a good deal criticized. I heard that a discussion concerning it took place at a country house, and a doctor, well known in Dublin, also a member of this society, contended very strongly against several who were there, that my picture was really a true representation of the way a horse actually does gallop. Wagers were made, for the majority were sporting men, and they backed their opinions. Two hunters were brought out, and ridden at a gallop by grooms, on the lawn in front of the windows, and it was decided that my friend the doctor was in the right. In my picture of the charge of the 16th Lancers at Aliwal I also made some efforts in this direction; but not as successfully as I perhaps would now, unless I deceive myself.

The action of leaping is governed by the same rules as that of galloping, for in fact a gallop is but a succession of small leaps; but there is this difference, that in a leap the horse alights on the two fore legs at the same instant—one hoof does not touch the

ground before the other, as in the gallop; and in taking off, although he generally makes the spring from one foot, as man does, he alights always on the two hind legs, just as a man leaps. In taking a flying jump, artists often represent the front legs stretched forward and the hind legs back; but the animal never does this. When the hind legs are back the front legs are drawn in under the shoulder; and when he brings the hind legs under his body the front legs are outstretched, they touch the ground lightly for a fraction of a second, and almost at the same instant the hind legs are carried on and alight on the ground in front of where the fore legs touched. In rising to what is called a standing leap, the position is always correctly delineated—the hind legs well under the horse, and his fore legs doubled in, so that the hoofs are under the elbow, which is the true action of the animal, and holds good in all leaps.

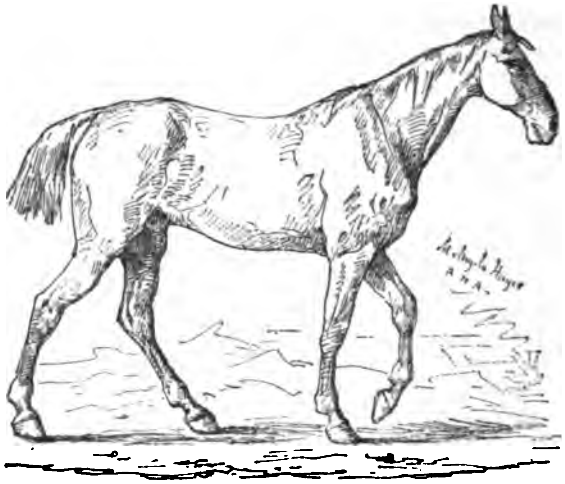
The horse trotting is usually much truer in its representation than the gallop—the near hind leg and the off fore leg are moved simultaneously, and occasionally it happens that the toe of the near hind hoof, as it is brought forward, strikes against the heel of the fore foot on the same side, as it rests upon the ground, and a click is heard. In pictures, two legs are represented on the ground and two off, raised a little. For a rapid trot all the four legs are sometimes shown as off the ground together, which is not wrong. In some American prints of fast trotting horses I have seen a ludicrously exaggerated attempt to represents great speed by curving the front leg and hoof up close to the girth, so that the flat surface of the shoe was horizontal—perfectly absurd, and quite untruthful.

The pace of walking is not, however, at all as well represented as the trot. By most artists the legs are represented in just the same position as at a moderate trot, only the legs are drawn stiff and straight, instead of curved, or else they are in the position of a slow trot: but the horse's action in the walk is very unlike a trot. The sound made by the fall of the four hoofs in a trot is as if but one leg touched the ground, as the off and the near one touch the ground at the same instant. Thus, the two sounds are heard as one; but in the walk, the four fall one after the other, and four distinct sounds reach the ear in succession—a slight rest between each two, as the time is marked in a *deux temps* waltz.

As the off hind leg is lifted from the ground and brought forward, it appears as if about to strike against the heel of the off fore leg, only that just as it seems about to do so, the fore leg is lifted forward; and the same, of course, with the near hind leg—the toe of the hoof never touching, as it frequently does in the trot. In fact, the print of the hind hoof is generally on top of the impression of the front one. There is a good deal of analogy between the movement of the gallop and the walk. The principle of the fore leg being carried forward, just as the hind hoof seems to be about to strike it, is common to both. The difference is, that the movement of the off and near side legs is alternate in the walk, but is very nearly simultaneous in the gallop. Figs. 12, 13, and 14

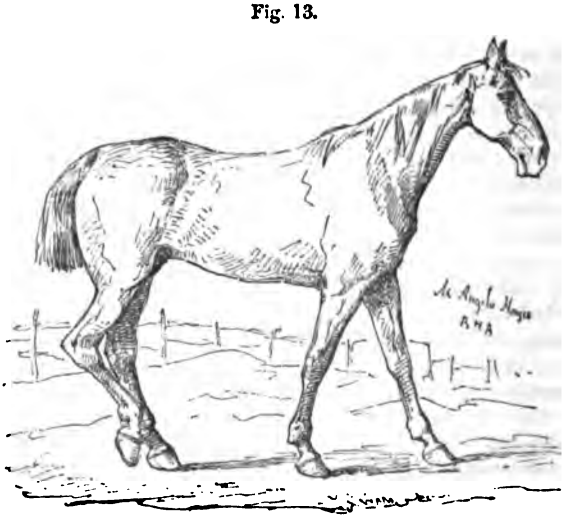
show the movement of the horse in the walking pace, from the lifting of the hind leg until it is again placed on the ground in advance.

Fig. 12.



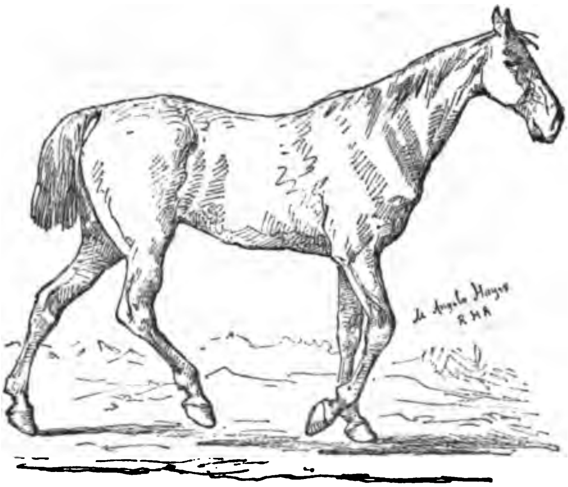
Miss Thompson's remarkable picture of the "Roll Call," lately exhibited at Mr. Cranfield's establishment here in Dublin, contains a horse as in the act of walking, upon which a field officer is mounted.

Fig. 13.



A very animated controversy was carried on in the London papers respecting the position in which she has delineated the legs of this horse. Miss Thompson, I fancy, is a keen observer, and she preferred to follow her own observation of nature, rather than the representations usually given, and, as a consequence, she was attacked.

Fig. 14.



Innovation and originality are always attacked. Byron, in his English Bards and Scotch Reviewers, says :—

> " Besides, every staring graduate would prate
> About what he ne'er could hope to imitate !"

There were a number of letters published ; but I am not aware that Miss Thompson defended herself. I happened, however, to have been drawn into the controversy, and I wrote a letter, accompanied with a few small illustrative sketches, which was published in the *Illustrated Sporting and Dramatic News* (London), also in the *Irish Farmers' Gazette* (Dublin.)* I know not if my letter was considered conclusive, but I believe it, at all events, concluded the controversy, for I saw no more letters. At the time I wrote my letter I had not seen Miss Thompson's very clever picture ; therefore, I confined my observations to a description of the actual movement of the horse ; but a very short time after I saw her picture in London, and I am quite satisfied she was correct in her rendering.

* This letter is appended at the end.

Fig. 15.

From the ROLL CALL, by Miss Thompson.

The last illustration I will submit to you is through the medium of the Phenakistiscope—an old French invention, known, I dare say, to many of my audience. It is, you observe, a revolving disc, upon which are several figures of the horse in the various positions, from the time he lifts his legs from the ground till the completion of the stride, when he is ready for a fresh bound forward. I have drawn these so accurately that the hoofs fit into the foot-prints of the animal. In all the drawings I have hitherto seen on these ingenious inventions, they have not succeeded in giving the true movement of the horse's legs in the gallop. The body is made to move, but the legs are drawn in the usual "extension movement," and, as a consequence, the horse looks flying through the air instead of galloping upon his legs.

I think it will be admitted, the diagrams or sketches I have made on this disc will present, when revolving, the exact appearance a living horse presents in the gallop. If there was the slightest deviation or inaccuracy in these figures, it would be at once evidenced in the disrupted appearance the combined figure would present when viewed through the perforations. They must *prove*, like a problem in Euclid or a sum in arithmetic; and I respectfully submit that these sketches "prove," and are also completely in accord with all the larger drawings I have placed before you this evening.

In conclusion, I thank you for the kindness with which you have so patiently listened to my exposition, and can only hope that in endeavouring to make my meaning plain, I may not have been too prolix or too tedious.

☞ At the termination of the lecture, the revolving Phenakistiscope was looked at and examined by most of those present, and was generally pronounced to be a faithful and accurate representation of the action of a living animal in full gallop.

CALLING THE ROLL.

TO THE EDITOR OF THE IRISH FARMERS' GAZETTE.

SIR,—I have read with much interest the observations which have lately appeared in many of the London papers upon the action of a horse when walking, as depicted in Miss Thompson's picture of "Calling the Roll;" and as an artist who has given much thought to the matter under discussion, and who has painted a vast number of pictures representing horses in action, you will, I trust, afford me a little space in your columns for a few additional observations.

I do not quite agree with the data laid down and quoted. For instance, in listening to the footfalls of a horse when walking, I find the sound is not, as stated, an even cadence or succession of 1, 2, 3, 4. It is more like 1, 2, with a very short pause, and then 3, 4, much as the time is marked in a *deux temps valse*. Again, when a horse walks, the near hind leg and the near fore leg move *almost* together, the fore leg appearing to be all but kicked on by the point of the hind hoof, but it is lifted from the ground a fraction of a second before the hind hoof reaches the spot on which the fore foot rested. Thus the animal moves to a great extent by simultaneously advancing the two side legs alternately, being quite different from the movement in a trot, when the near fore foot and the off hind foot go together and fall on the ground at the very same instant, the two sounding as one. The mistake is, however, generally made by artists of making the position of a horse's legs in walking exactly like trotting, save that they depict them straight in one case and bent in the other.

Watching a horse while he is walking, the observer will note that two hoofs rest on the ground for an instant—the off fore leg and the near hind leg, or *vice versa*, and one is twelve or fourteen inches in advance of the other. In the trot also two legs rest on the ground, only that the toe of the hind hoof nearly touches the heel of the front one. Another thing necessary to note is—that walking beside a horse, the animal also at a walking pace, if one steps in cadence or time with the hind legs, it will be out of time or step with the fore legs, and if one changes and steps along with the fore legs, the hind legs then are found to be out of time, from all of which it follows that to represent the horse as walking is a complicated and difficult matter in comparison with trotting.

Hence in depicting a horse in motion, the difficulty is to make a compromise between the appearance presented to the eye by the rapid action of the legs and their actual position. The animal draws up the near hind leg and places the hoof in advance of the off hind leg, and the onward motion of the body causes this off hind hoof, apparently, to fall behind. It is self-evident that as the legs pass each other one is nearly hidden by

the other, viewing the horse sideways; and if an artist selects this particular moment it will certainly not convey the idea to the mind of a spectator that the horse so represented is walking. To make my meaning plainer, I herewith append three sketches. Fig. 1 shows the off hind leg advanced; fig. 2 shows the same leg well back; and fig. 3 shows this leg passing across, or in front of the near hind leg. I have also shown the position the fore legs are in at the same moment, for it must be borne in mind that as the animal does not pace in the same time with the fore and hind legs – unlike trotting—the legs will be different. I also give two additional sketches, figs. 4 and 5, to show the position of the hind legs in what I may term an intermediate position from the other three. Now, these are very unlike the usual way in which a horse is represented in the act of walking; yet I am satisfied they represent as truly as it is possible to do in a sketch the actual and true positions of a horse as he moves one foot before another. I can prove this to demonstration if required. I know not whether the horse in Miss Thompson's picture at all resembles any of those five sketches, because I have not seen her picture, and therefore I avoid all criticism of the lady's work. My object is to show how very difficult it is to give a correct idea of motion, and at the same time point out that it is almost impossible to represent it truly, and yet truth is what we all strive after.

Before concluding my letter, I may observe that the way a horse is usually represented galloping is far more absurd, and contrary to truth and nature, than are the representations of his action in walking. He is usually depicted with the front legs stretched out to the fullest extent, and the hind legs just as extravagantly stretched out in the opposite direction —a position the animal never is in, and by no possibility could get into; and yet men who have been amongst horses all their lives, who study every point and every turn, who know every pace of a horse thoroughly—what he can do, and how he ought to be ridden—are yet, apparently, satisfied with the conventional and false representations I have described; pictures of races—every horse, even if there are twenty—depicted in the selfsame stride, as if galloping in as exact time, one with another, as soldiers march; only every hoof is in the air, and not one touching the ground from which the bellies of the animals are but sixteen or eighteen inches; *ventre à terre* with a vengeance.

In the last century artists represented the horse when galloping very nearly as I have described, with this difference, that the points of the hind hoofs are *always* on the ground, the front legs being thrust out and raised so that the body formed an angle of about twenty-five or thirty degrees with the ground. The old masters invariably adopted this method, which is just as false as the other, but it is remarkable that in all the sculptured horses that were on the Parthenon, most of them in action, not one in any respect resembles the conventional position chosen by the moderns. The old Greeks, when representing the fore legs thrust out, placed the hind legs well under the animal, being a much more truthful approximation to the way a horse gallops.

However, I fear I have already made my letter too long, and trespassed too much on your valuable space.

Yours, &c.,

M. ANGELO HAYES, R.H.A.

4, Salem-place, Dublin,

June 13, 1874.

XX.—*On an Impervious Material for Damp Courses in Houses.* By CHARLES A. CAMERON, M.D., Fellow and Professor of Chemistry and Hygiene, Royal College of Surgeons, Medical Officer of Health for Dublin, Hon. Fellow Royal Institute of Architects, &c.

[Read 21st February, 1877.]

SANITARY SCIENCE has of late years made such good progress that its professors are now fairly entitled to speak *ex cathedra.* They tell us that if we do certain things when we are building our houses and making our streets we are certain to promote the health and increase the longevity of the people who are to inhabit them. If persons knowingly build houses upon unhealthy sites, or if they fail to provide them with those appliances which are necessary to the maintenance of the health of the inmates, they are morally, and ought to be legally, responsible for the consequences which may ensue. It is a matter of notoriety that in this country human dwellings are built upon sites which are in great part composed of decomposing organic matter ("shot rubbish," as it is termed), and still more frequently in situations where the soil must ever remain damp and unhealthy, owing to irremediable topographical conditions. In Dublin there are too many houses placed under such deplorable conditions; and as there is no so-called "building law" in operation in this city, it seems difficult to prevent house jobbers from erecting dwellings for the humbler classes in places which cannot be drained, and upon ground artificially produced from rubbish of every kind. We are promised that a bill for a General Building Act for Ireland is to be introduced into parliament during the present session. If it become law—which, as a government measure, is likely to be the case—I can only say that no piece of legislation was ever more urgently required; for the great majority of the dwellings of the labouring classes in Irish towns are in an almost indescribably bad condition.

The healthy condition of a house depends upon several factors, of which in this paper I purpose to consider but one—namely, that of *site.* I have already stated that some sites are hopelessly or almost hopelessly bad, as, for example, those of old water courses, places lying below the sea level, &c. Some sites however, though bad, admit of being greatly improved, or, perhaps, of being rendered perfectly healthy. There are two enemies which may enter a house from the ground upon which it is built—namely, *foul air* and *damp.* Each produces or propagates more than one of the ills which flesh is heir to. Rheumatism, phthisis and other thoracic affections result from damp houses; and cholera, typhoid fever, and dysenteric disease are caused or propagated by foul air—which also, by lower-

ing the vital powers, predisposes those who continually inspire it to contract any disease of an epidemic or endemic type which may happen to be prevalent.

In the construction of most houses, from one-fourth to one-fifth of the brick or stone work is below the ground line. If we assume a house to contain 40,000 cubic feet of space, the foundations will probably enclose about 8,000 or 9,000 cubic feet of earth; even if this earth be tolerably dry, it will certainly contain at least 3,000 gallons of water. Now, bricks are very porous, and allow both gases and water to pass through them. Our houses would not be even so healthy as they are if their brick walls were rendered impervious to the passage of air and moisture, as some say they should be. But while we are glad to allow the air rendered damp by respiration of animals and the combustion of fuel, &c., to escape through our walls, and be replaced by pure, dry air—also transmitted through the porous bricks— we should endeavour to prevent the air coming into the house from below the ground line. The bricks in the foundations being in contact with the damp earth absorb moisture from the latter, and this moisture ascends by capillary attraction from brick to brick until it reaches the superstructures. I have seen damp ascend in this way 30 feet from the ground. Rooms rendered damp by moisture carried up from the foundations are not rarely, but constantly, a cause of disease, of discomfort, and also of injury to articles of clothing and furniture.

Architects and builders have ample experience of ground dampness affecting not only the basement, but some of the above-ground stories, and several remedies for the evil have been suggested, some of which are occasionally employed. In a few cases I have heard of a layer of sheet lead being interposed between the top of the foundation wall and the base of the superincumbent one. Welsh slates are very frequently used for damp courses; they are imbedded in cement. Vitrified earthenware tiles, of from one to one and a half inches thick, have recently been recommended for this purpose. A mixture of asphalte and sand is occasionally employed; it is poured whilst hot upon the top of the foundations about a foot above the ground line. It is also sold in sheets, similar to the asphalte material used for covering roofs.

There are objections to be urged against the materials now used in making damp courses. Lead is too costly, the asphalte does not sufficiently resist the pressure of the upper walls, and the slates and vitrified bricks are not quite impervious to moisture.

A patent has recently been taken out for the manufacture of a peculiar kind of brick, which appears to me admirably adapted for the construction of damp courses. The patentees are Major-General Scott, C.B., F.R.S.— so well known for his high engineering skill and his many ingenious inventions—and Mr. J. C. Bloomfield, of Castle Caldwell, county of Fermanagh. The latter gentleman is well known in Ireland as a most zealous advocate for the develop-

ment of our mineral and manufacturing resources, and is the founder of the celebrated Belleek china factory—the only one in Ireland.

The brick in question is made from a cement consisting almost wholly of a clay limestone, burnt and mixed with five per cent. of plaster of Paris. With this cement is incorporated about one-eighth of its weight of common coal tar. The cement bricks are placed in boiling tar, which passes into their pores, and, solidifying therein, renders the bricks absolutely impervious to the passage of moisture or gas.

The brick which I now exhibit was placed in water in my laboratory a week ago, where it remained until to-day. Its weight was taken before it was set to steep and when it was removed from the water, it was found not to have increased by even a single grain. Some bricks are so porous that they absorb one-fourth of their own weight of water, and even excellent facing bricks take up from 15 to 18 per cent. of water. Water has wonderful penetrating powers: the beautiful translucent pebbles which we gather from the sea beach contain water; keep them for a few hours in dry air and the translucency vanishes, because the water which had produced the optical appearance had dried out. The thickest walls, the hardest stones, will not keep out water; but there are two kinds of materials which refuse to commingle with water—these are common fats and tar compounds. The brick which I have here referred to has all the requisite qualities to render it available in the construction of damp courses in all kinds of houses—the cottage of the poor man as well as the mansion of the noble; that is, it is cheap, it resists pressure, it does not decay or change by exposure to air or damp, and it is absolutely impervious to moisture and air.

There is another purpose to which, I think, the material used in making these bricks might, with great advantage, be applied, namely, to prevent the air which circulates throughout the soil from passing into the house. Now, very likely, the air which issues out of the land may be innocuous; but from the results of the analysis of underground air made by Dr. Von Pettenkofer and others it is certain that it generally contains an abnormal amount of carbonic acid gas, which is—as most educated people know—a very deadly poison. It may, too, occasionally include sewage gases which have escaped into the soil from fissures in sewers and other sources. I take it we ought to regard the air which comes out of the land with grave suspicion: we ought, if we possibly could, prevent it from entering our premises through the floor of the basement story. Pettenkofer has, with great ingenuity of argument, endeavoured to prove that cholera and typhoid fever are mainly propagated by means of the underground air. That there are motions or currents in the subterranean air as well as in the general volume of the atmosphere has been conclusively proved. In loose, porous soils both air and water circulate more freely than

in tenacious, stiff clays. The soil, we know, is the receptacle of much of the effete matters produced in houses. Now, if in the soil of a particular place there be deposited the matters ejected from the body of a typhoid or cholera patient, the gases and vapours evolved therefrom may be transported to a considerable distance from the spot by the media of subterranean currents of water and of air. According to Pettenkofer, foul air of this dangerous and disease-laden nature frequently enters houses through the basement floor, and causes disease. The more porous the soil is, the more likely is it that the gases may escape from it into the atmosphere of the houses. A strong wind playing upon the surface of the ground outside the house may force a portion of the air out of the soil into the interior of the adjacent houses. Perhaps the salubrity of London is in part due to the stiff clay upon which it is built. This clay is not favourable to the passage of gases, nor of water either; but the superfluous moisture being removed by good drains, the soil is then more healthy than a very porous one, drained or undrained.

The tiles which Messrs. Scott and Bloomfield propose to manufacture appear to me to be well adapted for covering completely the surface of the ground enclosed within the walls of a house. The surface of the ground being made perfectly smooth, it should be covered with a layer of puddle, well rammed down, or, still better, with a coating of the cheapest concrete. Upon this surface the tiles should be laid, and cemented with a mixture of selenitic cement and tar. The tiles should be carried up to meet the damp course upon the top of the foundations. The drains, if they had to be carried under the house, should be placed below the flooring of tiles, and it would be desirable to lay them in a trench composed of the tile material. A house built over such a surface as that which I have described would be absolutely impervious to foul air from the soil; and should the sewer pipes be broken by the agency of frost or otherwise, no offensive emanations from them could by possibility enter the house. They would probably be carried off by under-ground currents to enter some neighbouring houses with basement porous floors.

The cost of a square yard of impervious tiles would, as I am informed, be 4*s.* 2*d.* in Dublin, the tiles being 1½ inch in thickness. At this rate a house of, say, 40 feet by 30 feet could be provided with a layer of the tiles beneath the basement floor at a cost not exceeding £20—a sum which appears by no means excessive, when the advantages of having such a foundation are considered.

To many persons it may seem improbable that air in any quantity could come out of the ground into our houses; but I have satisfied myself that such really is the case. When the doors and windows of the kitchen are closed, and fuel in large quantity is burning, the air may nearly always be felt rustling up through the fissures in the flags or tiles constituting the floor. The combustion of fuel in our dwellings undoubtedly causes a large insuction of air from

without, and it is better that air should come from the pure atmosphere, and not from the soil, in which coal gas, sewage gases, and other objectionable matters may, perhaps, be abundantly present.

That I have not exaggerated the importance of keeping our dwellings dry, I need but refer to the extraordinary results which have followed from the main drainage works undertaken in many of the large towns in England. For example, since the towns of Salisbury, Rugby, and Worthing have been dried by a thorough system of drainage the mortality from pulmonary phthisis has decreased 36 per cent. at Worthing, 49 per cent. at Salisbury, &c. In other towns similar happy results, but not of so striking a character, have followed the drying of the soil. These facts are so significant that surely they justify me in recommending that no reasonable expense should be spared to secure for our houses and our towns immunity from two of man's most deadly enemies —damp air and foul air.

XXI.—*On Marine Fog Signals.* By JOHN R. WIGHAM, M.R.I.A.

Being a discourse delivered on Monday Evening, April 16, 1877.

The Right Hon. the EARL of ROSSE, F.R.S., in the Chair.

WHEN damp air is of sufficiently high temperature its moisture is in the form of invisible vapour, but when cold currents come into contact with the warm air its watery vapour is condensed into minute liquid globules visible to the eye in the form of fog. The innumerable reflecting surfaces of the particles of which fog is composed obstruct the passage of light, just as transparent ice when broken into powder becomes opaque.

To no portion of the community are fogs more dangerous than to seamen, and hence the necessity for providing such fog signals as may aid them in the navigation of narrow seas, and by indicating the position of out-lying dangers, lead them safely "into their desired haven."

Marine fog signals may be said to be of two kinds—Luminous and Audible; the idea has, however, struck me that our olfactory nerves might likewise be brought into service, and a third system, to be called *Odoriferous*, be instituted. I have little doubt but that some volatile substance, for example, perhaps some carbolic acid compound, may be found of such pungent and peculiar odour that a small quantity thrown into the sea at a lighthouse or lightship would float on the water, and so pervade the atmosphere with its odour as to serve as a warning to mariners.

I propose this evening to begin with a short reference to

Luminous Fog Signals.

In a paper which some years ago I had the honour of reading before this Society I gave some account of the improvement of lighthouses by the introduction of gas as the illuminating agent,

and I showed the extent to which at that time the use of gas had rendered them capable of showing fog signals to the mariner, as well as at the same time fulfilling their ordinary function of guiding him in clear weather. In that paper it was shown that while gas-flames have not the same degree of *intensity* as such lights as the lime light and the electric light, yet being possessed of greater *quantity* they have better effect in illuminating fogs than smaller though more intense lights. *Dr. Siemens, no mean authority in such matters, expresses a decided opinion that the *quantity* of light for distant effects is more important than its *intensity*, and that if light be regarded as a vibratory motion of the medium through which it is transmitted, any obstructive matter in the form of haze or smoke must exercise a destructive effect according to the square of the "energy of vibration or intensity of the light." Without endorsing entirely this remark of Mr. Siemens, I would just remind you in the words of Dr. Tyndall, that "The sense of external brightness depends upon the brightness of the internal retinal image, and not upon its size." Therefore, the size of an intense light is only apparent and not real. The optical delusion by which a white object appears larger than a black object of the same size is a somewhat analogous case.

In the matter of the illumination of fog—it appears to me that it is simply because a greater quantity of fog is illuminated by a large light than by a smaller one (even though more intense) that the effect of the larger light is better. I had an opportunity of making a very conclusive experiment on this point a year or two ago in London, when my lighthouse gaslight was tested against one of Gramme's powerful electric lights at the clock-tower of the House of Commons. The lights were placed side by side, and the observers proceeded to Primrose-hill, from whence a good view of the clock-tower is obtained. At first, the night being clear the electric light far outshone the gaslight, but a fog coming on, the reverse was soon the case, and long after the electric light had been obscured the gaslight was distinctly seen.

"† The most intense lights we can produce artificially are as nothing compared, surface by surface, with the sun. Take, for example, the lime light. The sun's light is equal to 146 lime lights each of the size of the sun, and when we remember that the sun's light received on the whole of this earth is but the 2,000 millionth part of the total light given forth," we may have some faint idea of the vast quantity of the light which proceeds from that great source of day, and how powerless our puny lights must be in comparison. We all know that even the sun's rays but feebly penetrate dense fog, and therefore it may seem hopeless to seek help from any artificial light. The fact is, that in *really* dense fogs all lights are useless. But when fogs are not *very* dense, when the weather is

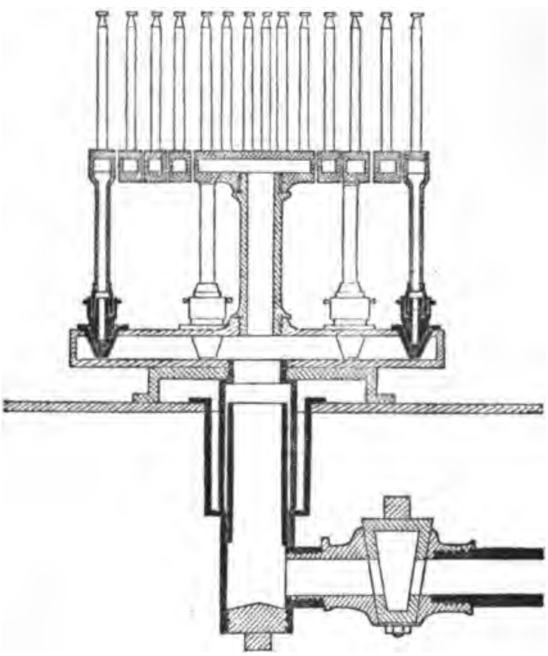
---

* Transactions of Institute Civil Engineers.

† Sir John Herschel: Familiar Lectures on Scientific Subjects.

merely what is called "thick," but sufficiently so to obscure ordinary lights, then the mariner may derive much benefit from powerful lights such as I am about to describe. It seems to me reasonable to suppose that the nearer in our fog lights we approach to the diffusive nature of sun light, the more useful will they be, and if by using large lights we are able so to illuminate the particles of fog as to show to the sailor even an ill-defined luminous patch when all ordinary lights are invisible, it may be to him the difference between safety and shipwreck, life and death. This gas lamp (Fig. 1)

Fig. 1.



is so constructed that a lightkeeper can increase the power of the light by five *steps*, according as the state of the weather may seem to require it from the burner used in clear weather, consisting of 28 jets to the 2nd, 3rd, 4th, and 5th fog powers, consisting of 48, 68, 88, and 108 jets respectively. The changes from one power to another can be made very quickly, as I shall presently show you. The gas we have here, and which I propose to burn in this lamp, is of what is termed sixteen-candle illuminating power; the gas used at lighthouses is generally about thirty-two-candle illuminating power; therefore, you will kindly make the somewhat easy mental calculation as to the degree in which the lamp in actual use at lighthouses exceeds in power that which I will now proceed

Fig. 2.

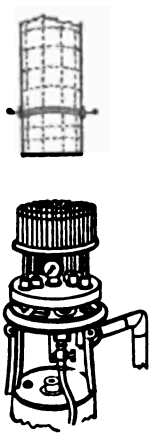
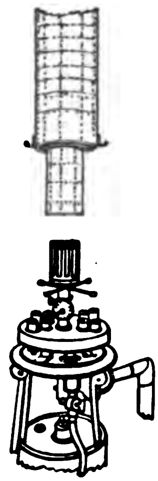


Fig. 3.

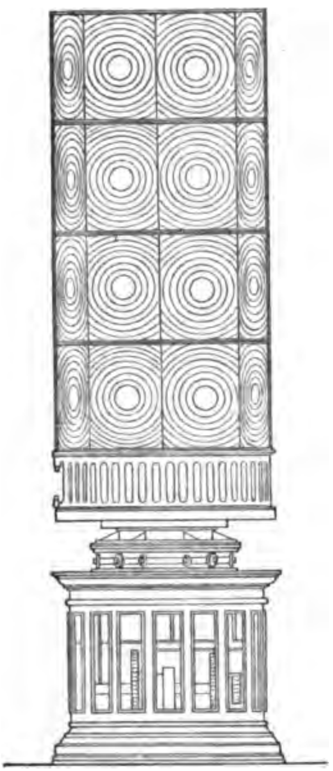


to show you. Figures 2 and 3 show this gas lamp in its position in a lighthouse.

The power of the gas burner at which we have just been looking is, of course, very much increased by the use of lenticular apparatus. I have here what is termed an annular lens of the kind used in first-order lighthouses, and by turning it in front of the light you can judge of the effect. I will move it in the same way that such lenses are moved to cause what are termed in lighthouse parlance revolving or flashing lights, and the beam will thus traverse every part of the room.

The good effect of these large gas flames in so illuminating fog as to be useful to the mariner appeared to me, after long practical observation, to be simply undeniable; and being firmly convinced of the soundness of the principle of applying large lights for fog illumination, I determined to push the application still further. I accordingly devised a plan of doubling, trebling, and quadrupling the power of the largest gas light and lens at which we have been looking. This plan, which has been termed the Biform, Triform, and Quadriform system, consists in placing the burners vertically over one another, and making an arrangement by which the products of the combustion of the lower burners are intercepted and turned outwards, so as not to interfere with the upper burners, while a supply of pure air is conveyed to each of them by horizontal pipes brought through the flue. The air thus introduced is sucked in briskly by the draught, and much heated by its contact with the nearly red-hot casing of the internal flue; the illuminating power of each of the flames is thus materially increased. I have here a model of a quadriform apparatus which I am erecting at the new lighthouse of Galley Head, county Cork. There are thirty-two lenses arranged in four tiers, eight in each tier. Each lens is of the size of this first-order lens, and one of these powerful gas lights is placed in the focus of each tier; thus there are four burners placed over each other. As the lenses touch each other the lights blend at a few yards distance, and form a great pillar of light, the illuminating power of which is calculated to be equal to more than a million sperm candles. Figure 4 shows this quadriform light.

Fig. 4.



Dr. Tyndall, whose reports on the use of gas instead of oil for lighthouses, made at the instance of Government, are entirely favourable to *gas*, in one of them gives a remarkable example of the fog-penetrating power of a triform light, which was observed by Sir William Thomson. He says:—

"The observation which I have now to cite is a striking confirmation of those above referred to. It was made by Sir William Thomson from the Salthill Hotel, on the 21st of last September. Speaking of the performance of the triform light, he says:—'The triform light exhibited from the lower position in the neighbourhood of the chief tower was strikingly superior even to the great fog power of 108 burners exhibited in the chief tower, so much so that a heavy thunder shower which happily chanced to pass during our experiments between the Salthill Hotel and the lighthouse completely eclipsed the light of the chief tower, while the triform still shone conspicuously through it.' The superiority of the triform over even the 108-jet burner being thus marked, its enormous superiority over the 28-jet burner, or its equivalent 4-inch lamp, may be inferred."

The dimensions of the usual lanterns and dioptric apparatus of lighthouses not permitting further increase in the *size* of our lights, we come now to consider how far we can usefully add the element of intensity to that of quantity. All our intense lights, such as the lime light, the electric light, magnesium light, &c., are costly; but it occurred to me that if I could add some such intense light to my large gas burners, so arranged that it need not be used except in thick weather, I would, at comparatively small expense, accomplish the desired end, viz., a fog-light combining both quantity and intensity. I made many experiments, and at length devised what I termed a core burner. I place it in the exact focus of a lighthouse lens, so that every portion of its light shall be transmitted in parallel rays towards the horizon. Any of the intense lights I have mentioned might form this core, for example, the electric light, but I prefer as the simplest and least expensive a rich hydro-carbon flame, intensified by oxygen. With respect to this light, I will ask you to remember that it is essentially a fog light, and is only intended to be used during fogs. It can be applied in a moment, so that no expense is incurred, except while the fog

lasts, and during that time (it appears to me that) *no* expense should be considered too great when the possible saving of human life is taken into account.

I have one of these burners here, but before lighting it must again refer to the quality of our gas. To do the burner justice, the rich cannel gas burned at lighthouses, should be used, the sixteen-candle gas of the city not possessing sufficient carbon for the development of its full effect. The lamp which I have here gives, in a simple way, a good idea of the respective illuminating powers of the city gas, and of gas richer in hydro-carbon. It is filled with an extremely volatile liquid called gasoline. The vapour of this liquid passes into the flame when a tap is opened for the purpose, and the gas burns in the ordinary way when the tap is shut off; you will observe the marked difference in the illuminating effect as I turn the tap off and on.

I have dwelt upon this so much that you may understand how much more illuminating the core burner, which I will now show you, in connexion with the lighthouse lamp at which we have been looking, would be, if it were supplied with the rich cannel gas of lighthouses. You will observe the manner in which the map on the wall is illuminated by the core burner, and how dimly it can be seen when the core is turned off.

Gun flashes illuminate fog in a very powerful manner. Most explicit testimony on this subject has been given by Captain Galwey of the Board of Irish Lights' steamer *Princess Alexandra*. It will be found in the printed Parliamentary Papers on Fog Signals. The Commanders of the Holyhead Mail steamers, in answer to my inquiries, have also related their experience of the value of gun flashes in foggy weather, and stated that by their help they have frequently steered a safe course into harbour, even when *no sound* reached them. Their statements to that effect have *also* been printed, and will be found in the same parliamentary papers. I shall read you what is said by Captain Triphook, who was then in command of the Royal Mail steamer *Ulster*.

"Kingstown, November 23rd, 1873.

"SIR—In answer to your inquiry, I beg to say that I have found the guns stationed on the Kish Light and the North Stack Lighthouse to be of great service to me in thick weather when approaching the harbours of Kingstown and Holyhead respectively. When the lights of the lightship and of the Stack Lighthouse have been quite invisible by reason of the density of the fog, I have distinctly seen the flash of the gun making, as it were, an impression on the fog and indicating quite plainly the position in which the gun was placed. In some cases I have been able to see the flash when no sound from the gun has reached me; and I am therefore of opinion that the more brilliant such flashes could be made the better for maritime purposes.

"I am, yours truly,

"(Signed), RICHARD S. TRIPHOOK,

"Commander *Ulster* Royal Mail Packet."

The illumination of fog by flashes of light also takes place to a remarkable extent when the large gas burners which I have just described, are suddenly ignited, and the use of gas as an intermittent light for lighthouse purposes is valued, not only because of its

economy (the intermissions being caused by the cutting off and consequent cessation of the combustion of the gas), but also because of its illuminating effect on fog by the sudden exhibition of its light, as I have just mentioned.

An observation somewhat similar to that of Sir William Thomson, was recently made by Mr. Hamilton, of the Harbour Department of the Board of Trade, and Mr. Gray, of the Marine Department of the Board of Trade, on the occasion of a recent visit of those gentlemen to Dublin; the quadriform light was under experiment at Howth Bailey, and the weather having become very thick, they not only saw the large light when the fog had obscured the ordinary lighthouse light, but had also the opportunity of observing the good effect of the flashing of the former. The lights themselves were invisible, but at every flash the illumination of the fog arrested the eye, even when not turned in the precise direction of the light. The ignition of some fine gun cotton behind this screen of glass which I have covered with tissue paper to represent the obstruction of light by fog, will give you an idea of the forcible way in which the sudden display of a large light arrests the attention, and directs it to the point illuminated.

The usefulness of strong naked flames in fogs is well known. Pilot vessels are provided with what are termed flaring lights; they are generally torches dipped in turpentine, which the sailors bring into rapid contact with the oxygen of the air by waving to and fro. These are, however, but rude appliances compared with the large smokeless lamp which I have here, and which gives a uniform large flame of great intensity. It is applicable at all lighthouse stations, where gas or steam is used. Petroleum or gas is the light-giving material, and you will see that a current of air so feeds the flame as to cause its great illuminating power.

Now let us turn to the subject of

Audible Fog Signals.

The first signal of this kind of which we have record (though probably it was designed for storm rather than for fog) was the famous Inch Cape Bell. Fixed to the dangerous rock by the good Abbot of Aberbrothwick, it did its useful work till destroyed by the wicked hands of Sir Ralph the Rover, who, years afterwards, paid the penalty of his misdeed in the loss of his own life by shipwreck on this same rock, as described in the well-known poem.

Now, the warning bell, instead of being swung by the ceaseless roll of the ocean, is tolled by machinery in the balcony of the noble Bell Rock Lighthouse.

Bells were, for many years, the only fog signals attached to lighthouses. They have, doubtless, been of use, but as a whole have proved quite inadequate as fog signals. They are, however, still to be found at most lighthouses, and there are many bell-buoys in use round the English coast.

Since the year 1856 guns have been used at some lighthouse stations. They have done good service to navigation, and will, doubtless, continue to hold an important place in every well or-

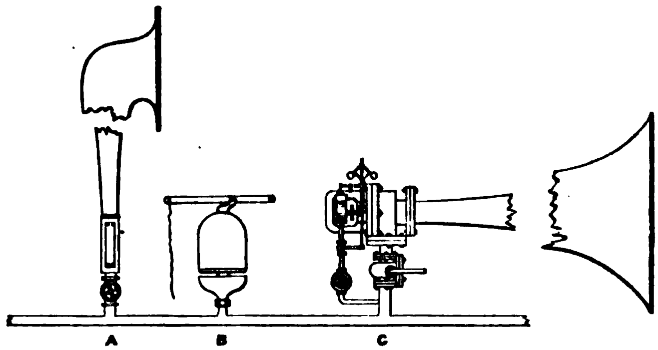
ganized system of coast fog signals, but they would be still more serviceable if the sound were not of such short duration as to be easily carried away by wind or lost in the presence of nearer and more powerful noises. From the same cause it is with difficulty that the listener can fix upon the precise place from which the sound proceeds.

I shall have again to refer to guns as fog signals when mentioning some recent experiments conducted by the War Office at the request of the Trinity House.

To the Americans belong the honour of being the first to organize a systematic inquiry into the subject of audible fog signals. The constant recurrence of dense fogs upon their eastern coasts, lasting frequently for many consecutive days, appears to have stimulated them to exertion in the matter. In the year 1855 the Lighthouse Board of the United States directed a series of experiments to be made with the view of improving this branch of their service. Many instruments were tried, and the result was that they established steam fog whistles and fog trumpets at several of their most important shore stations and lightships. The whistles were of the same kind as are used in locomotive engines, and were sounded at regular intervals by automatic machinery. The trumpets were large reed instruments sounded by compressed air. They were the invention of Mr. Daboll of New London, and have ever since borne his name. Horse-power was at first used to compress the air by which this trumpet was sounded, but the inconvenience of keeping at a lighthouse a pair of horses, or, as it would now be expressed by lighthouse authorities, a horse in duplicate, led Mr. Daboll to seek for a more suitable motive power. After some time he applied the Ericsson hot-air engine for that purpose, and his trumpet, thus worked, still ranks as a first-class fog signal. Many of them are in use in America, and several in England. The only one in Ireland is fixed at Howth Bailey, and some of you who reside on the Kingstown side of the bay may possibly regard its monotonous wailing as decidedly unpleasant.

I have here a Daboll trumpet for your inspection (Fig. 5 A).

Fig. 5.



The sound is produced by the vibration of a steel reed fixed in a peculiarly shaped orifice; when the instrument is in action the reed is covered by this brass trumpet, the mouth of which can be turned to any part of the horizon, the rotation of the trumpet is generally caused by automatic machinery worked by the air engine which also opens and closes the sounding valve at regular intervals. I trust none of you, ladies or gentlemen, may be inconvenienced by the loudness of the sound, but, believing that it would be more interesting to you that I should place before you the actual instrument than any mere model or diagram, I have (at the cost of some labour) ventured to do so in this case, and have also adopted the same course in most of the other illustrations which I have the honour of submitting to your notice this evening. I will first for comparison sound a powerful fog whistle kindly lent me by Mr. Bailey of Salford. He calls it a *Roarer*—a most descriptive name. It is similar to those which are largely used in the United States and in Canada (Fig. 5 B). I will also sound for your information, a very useful hand fog horn invented by Mr. Holmes, of London, and kindly lent me for this evening's lecture by Mr. Russell, his Dublin representative (Fig. 6).

Fig. 6.

In 1865 many further experiments were made by the United States Lighthouse Board, chiefly to determine whether reflectors assist the transmission of sound. The experiments were made under the superintendence of Professor Henry, the chairman of the Board. A reflector, having a surface of sixty-four square feet was constructed, and it was found that within a distance of 500 yards it increased the sound, beyond that distance it had but small effect, and the result of that and many similar experiments, which were made, led to the conclusion that practically reflectors were of little use; for instance, whistles were heard as well *behind* a reflector as in its focus. It was also made clear by experiment that the bell of a steam whistle may be made of any metal or even of wood, the resonance of the whistle being due to the vibrations within the cavity of the bell, and not to the material of which it is composed. Among the instruments tried on that occasion were double whistles placed mouth to mouth, with and without trumpets. Bells fixed horizontally and mouth upwards, with and without reflectors, also the curious instrument of which I have here a model. It is simply a tube bent into the shape of the letter U, and half filled with water, each end of the tube is fitted with a whistle. The instrument was intended to be placed on board a lightship, the rocking of the vessel

to cause the water to compress the air in the tube, and thus sound the whistle.

Several strange anomalies as to the transmission of sound were observed during these American experiments. For example, trumpet sounds 7⅝ miles distant, *in*audible on the deck of the observers' ship, were heard at the mast head. On another occasion similar sounds unheard at 4⅜ miles with a *favourable* wind, were distinctly audible at a distance of 6¼ miles *against* the wind. Another remarkable fact was mentioned by General Duane, officer in charge of the Lighthouse District No. 1 :—

"At Cape Elizabeth, nine miles south-easterly from the General's house at Portland, is a fog signal consisting of a whistle 10 inches in diameter. At Portland Head, about four miles from the same city, in nearly the same direction, is a Daboll trumpet. There can be no doubt, says the General, that those signals can be heard much better during a heavy north-east snow-storm than at any other time. 'As the wind increases in force, the sound of the nearer instrument, the trumpet, diminishes, but the whistle becomes more distinct; but I have never known the wind to blow hard enough to prevent the sound of the latter from reaching this city.' In this case, the sound comes to the city in nearly direct opposition to the course of the wind."

It is evident that no small amount of labour was bestowed upon these investigations, but although the American Lighthouse Board tried so many instruments none were *then* found superior to the Daboll trumpet, and the ordinary steam whistle unassisted by any reflector.

The United States Board renewed their experiments in 1867, chiefly to investigate the merits of a new instrument called a steam siren, which, under the direction of the Board had been constructed by Mr. Brown of New York. Its power was tested against the Daboll trumpet, and against steam whistles. The tests were made on land by an ingenious apparatus (in which the power of the vibrations of the sound were shown by the motions of sand sprinkled on strained parchment) called an artificial ear; and also at sea by steaming away till the sound was lost to the *natural* ear. The siren proved largely superior to the whistles tried against it; and also, but in a less degree, to the Daboll trumpet. Professor Henry thus describes the American siren :—

"Suppose a drum of short axis, into one head of which is inserted a steam-pipe connected with a locomotive boiler, while the other end has in it a triangular orifice, through which the steam is at brief intervals allowed to project itself.

"Immediately before this head, and in close contact with it, is a revolving disc, in which are eight orifices. By this arrangement, at every complete revolution of the disc the orifice in the head of the drum is opened and shut eight times in succession, thus producing a rapid series of impulses of steam against the air into the smaller orifice of the trumpet placed immediately in front of the revolving disc. These impulses are of such intensity and rapidity as to produce a sound unrivalled in magnitude and penetrating power by that of any other instrument yet devised.

"The siren was operated by an upright cylindrical tubular boiler, with a pressure of from 50 to 100 pounds on the square inch."

This diagram kindly lent me by Professor Barrett, shows some of the details of this instrument.

A siren, as now constructed in America, is on the table

through the kindness of the Commissioners of Irish Lights. It may be examined at the conclusion of the lecture, before which, however, I propose to let you hear the siren's song. At first the siren, unlike the Daboll horn, was sounded by steam, now, however, both instruments may be sounded either by steam or air, the result as to the sound being very much the same in either case.

It is not surprising that the Trinity House of London when tidings reached them that our Transatlantic brethren had introduced so powerful a fog signal should determine to look into its merits. They were well aware that much attention had been given both in Canada and the United States to the important subject of fog signals, and therefore in 1872 they appointed a committee, of whom the late Sir Frederick Arrow, the then Deputy Master was one, to visit those countries and investigate it. The report of their careful and extended inquiries is published as a Parliamentary paper, and is well worth perusal. They stated that they did not then propose to adopt the signal; and they go on to say—

"That as no such lengthened foggy period of the year as exists on the American Continent obtains on our coasts, and the days on which fog partially prevails do not exceed 60 or 70, there is no occasion for us to contemplate so extensive an application of fog signals as is found necessary in that country; although we consider that in a modified degree, they may be established more freely than at present."

How far this recommendation fell short of the ultimate decision of the Trinity House we shall presently see. Early in the year 1873 Dr. Tyndall, Scientific Adviser of the Trinity House, commenced a course of experiments and observations on fog signals at South Foreland lighthouse. A committee of the Elder Brethren, one of whom was the present deputy-master, Admiral Sir Richard Collinson, assisted in the investigation. The record of their proceedings is contained in two long Parliamentary papers, which are very interesting; and the interest they excite not only arises from the graphic manner in which Dr. Tyndall tells the story, but also from the important scientific discovery to which the experiments led him. The instruments tried were the American siren, Daboll's trumpet, whistles from Canada and the United States, also English steam whistles, and three different kinds of guns. They were placed on the cliffs near the lighthouse, and the effects of the sounds were judged of at sea from on board the steamers of the Trinity House. The experiments began on the 19th May, 1873, and were not completed until the year 1874. The result is thus summed up:—

"At present there are three kinds of instrument practically available for future service as fog signals, viz., the syren, the trumpet, and the gun.

"It is to be hoped that before very long our coasts will be guarded by a complete chain of sound signals, all effective and useful to the mariner; no unnecessary delay need now occur before proceeding to supply the light-ships and the important stations already selected by the Board, and when they are all established the lights rendered useless at a quarter of a mile by fog will be superseded by sound signals capable of warning the mariner at a minimum distance of three miles."

Further on, in the same Parliamentary paper, it is intimated that the Board of Trade had, at the special request of the Trinity House, sanctioned the expenditure of no less a sum than £33,650 for the erection of fog signals (mostly sirens driven by hot-air engines), at thirty-two stations on the coast of England, so powerfully did the evidence of the experiments affect the mind of the Elder Brethren, causing such a complete change of policy in so short a time. With respect to Professor Tyndall's discovery, it is necessary first to observe that prior to this investigation it was universally believed that clear still air was the best vehicle for the transmission of sound, fog being generally considered an obstacle. Up to July 3rd the numerous experiments which had been made were most perplexing, and apparently contradictory. Dr. Tyndall in his own account of them says:—

"Up to July 3 all remained enigmatical; but on this date observations were made which seemed to me to displace surmise and perplexity by the clearer light of physical demonstration. On this occasion we first steamed to a point 2·9 miles S.W. by W. of the signal station. No sounds, not even the guns, were heard at this distance. At two miles they were equally inaudible. But this being a position at which the sounds, though strong in the axis of the horn, invariably subsided, we steamed to the exact bearing from which our observations had been made on July 1. At 2.15, P.M., and at a distance of three and three-quarter miles from the station, with calm clear air and a smooth sea, the horns and whistles (American) were sounded, but they were inaudible. Surprised at this result, I signalled for the guns. They were all fired, but though the smoke seemed at hand, no sound whatever reached us.

"On July 1, in this bearing, the observed range of both horns and guns was ten and a half miles, while on the bearing of the Varne light vessel it was nearly thirteen miles. We steamed in to three miles, paused, and listened with all attention, but neither horn nor whistle was heard. We steamed on in the same bearing to two miles, and had the guns fired point blank at us. The howitzer and the mortar, with 3-pound charges, yielded a feeble thud, while the 18-pounder was wholly unheard.

"What on July 3, with a calm sea as a basis for the atmosphere, could so destroy its homogeneity as to enable it to quench in so short a distance so vast a body of sound? My course of thought at the time was thus determined:—As I stood upon the deck of the 'Irene' pondering the question, I became conscious of the exceeding power of the sun beating against my back, and heating the objects near me. Beams of equal power were falling on the sea, and must have produced copious evaporation. That the vapour generated should so rise and mingle with the air as to form an absolutely homogeneous medium was in the highest degree improbable. It would be sure, I thought, to rise in invisible streams, breaking through the superincumbent air now at one point, now at another, thus rendering the air flocculent with wreaths and striæ, charged in different degrees with the buoyant vapour. At the limiting surfaces of these spaces, though invisible, we should have the conditions necessary to the production of partial echoes and the consequent waste of sound. Ascending and descending air-currents of different temperature, as far as they existed, would also contribute to the effect. Curiously enough, the conditions necessary for the testing of this explanation immediately set in. At 3.15 P.M. a solitary cloud threw itself athwart the sun, and shaded the entire space between us and the South Foreland. The heating of the water, and the production of vapour and air-currents were checked by the interposition of this screen, hence the probability of suddenly improved transmission. To test this inference the steamer was immediately turned, and urged back to our last position of inaudibility. The sounds, as I expected, were distinctly though faintly heard. This was at three miles distance. At three and three-quarter miles the guns were fired, both point blank and elevated. The faintest pop was all that we heard; but we did hear a pop, whereas we had previously heard nothing, either here or three-quarters

of a mile nearer. We steamed out to four and a quarter miles where the sounds were for a moment faintly heard. At 5 P.M. the horn sounds were heard, they were succeeded after a little time by the whistle sounds, and both increased in intensity as the evening advanced.

"On our return to Dover Bay at 10 P.M. we heard the sounds, not only distinct but loud, where nothing could be heard in the morning."

"Thus the discrepancies which had been observed in the previous experiments were proved to be due to a state of the air which bears the same relation to sound that cloudiness does to light. By streams of air differently heated, or saturated in different degrees with aqueous vapours, the atmosphere is rendered *flocculent* to sound. *Acoustic clouds*, in fact, are incessantly floating or flying through the air.

"Ærial echoes of extraordinary intensity and of long duration are thus produced. They occur, contrary to the opinion hitherto entertained, in the clearest air.

"The existence of those ærial echoes has been proved both by observation and experiment. They may arise either from air-currents differently heated, or from air-currents differently saturated with vapour.

"Rain has no sensible power to obstruct sound.

"Hail has no sensible power to obstruct sound.

"Snow has no sensible power to obstruct sound.

"Fog has no sensible power to obstruct sound.

"The air associated with fog is, as a general rule, highly homogeneous, and favourable to the transmission of sound."

It is admitted, however, that the transmission of sound is much affected by winds—

> "Those viewless, shapeless, trackless things
> That mock all our imaginings
> Like spirits in a dream."

And hence it is an instruction to the keepers of fog instruments to have the trumpet mouths of the instrument always turned against the wind, so that its whole impulse may be given in the direction in which there is most resistance to the passage of the sound.

Dr. Tyndall subsequently made many experiments in the Royal Institution which corroborate in the most interesting way the conclusions to which the large-scale experiments at sea had led him. One of the most striking of these experiments illustrates what has been said of the manner in which gases or vapours of different densities when present in the atmosphere impede the passage of sound. Some time since I happened to mention to Professor Barrett, of the Royal College of Science, that I had this lecture in prospect, when he was so good as not only to say that he would lend me some apparatus to show this experiment, but also in the kindest manner to offer to perform the experiments himself. Considering the conspicuous part which Professor Barrett has taken in the investigation of the nature of sound and light, and in the development of that admirable means of rendering visible the effect of the former (I refer to the sensitive gas flame), I feel it to be no ordinary honour that I should have his assistance this evening. He will now perhaps kindly show the experiment of which we have been speaking.

The conclusions of Professor Tyndall, satisfactory as they appear to us, have not been allowed to pass unquestioned. Professor Henry, chairman of the United States Lighthouse Board, has

boldly challenged their correctness. He attributes the capriciousness of the atmosphere in conveying sound to the action of high and low currents of air, and one part of his reasoning is at first sight sufficiently plausible. He says :—

"A fatal objection, we think, to the truth of the hypothesis Professor Tyndall has advanced is, that the obstruction to the sound, whatever may be its nature, is not the same in different directions. We think we are warranted in asserting that in the case of acoustic opacity which he has described, if he had simultaneously made observations in an opposite direction, he would have come to a different conclusion. That a flocculent condition of the atmosphere should slightly obstruct the sound is not difficult to conceive; but that it should obstruct the ray in one direction and not in an opposite, or in a greater degree in one direction than in another, the stratum of air being the same in both cases, is at variance with any fact in nature with which we are acquainted."

To this Dr. Tyndall has effectively replied in the last edition of his book on "Sound." He shows that the non-reciprocity of sound is due to the distance of the acoustic clouds from the source of the sound and their relative position to each other. He quotes the result of a very remarkable set of experiments tried in France in 1822, at which Humboldt and other philosophers were present, as proof of the correctness of his theory, which he has further demonstrated experimentally at the Royal Institution. Professor Barrett will kindly show you an illustration of this.

In a recent lecture in this room Professor Barrett showed us an experiment illustrating the reflexion of sound by the interposition of a medium destroying the homogeneity of the air, and in this lies the whole gist of Dr. Tyndall's discovery; not only does what he terms a mottled condition of the atmosphere, i.e., alternate layers of vapour or gas of unlike densities interrupt the passage of sound, but being a real though invisible barrier, it also reflects the sound, and this was the cause of the beautiful ærial echoes which astonished the observers at South Foreland.

Professor Barrett will make this clear by his experiment.

To turn again to the practical part of our subject, I may, perhaps, be allowed briefly to refer to a matter somewhat personal to myself. I also have made a siren. Using a model obtained from Mr. Yates I made a steam siren, which I afterwards converted into a first class fog signal. I regret to say my neighbours called this Irish siren (Fig. 5 C) a *Banshee*. The town councillor representing the ward in which my works are situated described it in his place in the council chamber as "like the combined howlings of ten thousand demons hovering over the whole city." Unflattering statements of this kind reached me continually. I was entreated to desist, abused, scolded, held up to odium by the public press, threatened with actions, and visited by police inspectors sent specially from Dublin Castle. Everyone who heard it spoke EVIL of the siren, from judges whose ears it assailed even on the bench, to the respectable hair-dresser who tremblingly informed a corporator, whose hair he was cutting, that nothing earthly produced that noise, and it evidently foreboded the end of the world. All this

appeared to me strong evidence of the power of the siren, and induced me to believe that however disagreeable to dwellers in the city, to sailors it would be valuable as a fog signal. I therefore brought the subject under the notice of lighthouse authorities, and the Board of Irish Lights took the matter in hands, and determined that the Irish siren should be given a fair hearing. Accordingly, a siren was placed near Howth Bailey Lighthouse, and tested against the Daboll horn. The experiments were under the charge of Captain Morant, R.N., and although, owing to the temporary manner in which the siren was necessarily erected, and the difficulty of placing it in such a position as to secure a proper comparison with the Daboll, the experiments were not in all respects quite satisfactory, yet on the whole the Board were well pleased with the result, and decided to erect one of these sirens at Poor Head, county Cork; and the Board of Trade have since at their request sanctioned the expense of erecting a second at the same place. Thus the Irish siren will be first put into operation in Ireland, and I trust its song may soon be heard in other countries. The Trinity House Corporation do not work any of their sirens by steam, preferring to use air compressed by hot-air engines. In this I feel convinced they are mistaken, and I venture to predict that the Irish steam siren will be in good working order long after the English air sirens have become worn out, the constant action of fire upon the latter causing far more wear and tear than is possible in the case of a steam boiler.

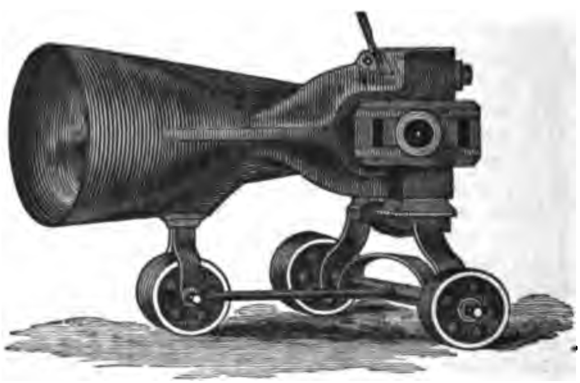
The Irish siren is applicable to steam ships as well as to lighthouses. The first which I made was similar to the American instrument, with one important difference, that the slits in the revolving disc were constructed with bevelled edges, and it was thus caused to rotate by the direct action of the steam without the intervention of any machinery, precisely on the principle of the original siren invented by Cagniard de la Tour. Professor Barrett will kindly show you one of his sirens.

The siren thus constructed is particularly suitable for steam ships, being so simple that the smallest boy in the ship could set it to work in a moment. This arrangement, though satisfactory for ships, is not so good for lighthouses where the sound is required to travel to a greater distance. It was found that the speed of the disc became so great as to render the sound almost inaudible, and although the dying shriek of the siren, as it approaches the point of inaudibility, was peculiarly weird and unmistakable, and such as a few years ago would have been considered to have perfectly fulfilled the purpose of an effective fog signal, yet on the whole it was inferior in range and power to that of the prolonged uniform note, which is to be obtained by the use either of a suitable governor, or of some kind of driving machinery. In the case of the siren which is here, you will see that I use a simple governor to maintain uniformity of speed. Instead of discs, as in the American sirens, I use two concentric cylinders, one fixed, the other

revolving. I believe this plan was invented by Mr. Slight, the foreman of the workshops of the Trinity Corporation; and I am indebted to their eminent engineer-in-chief, Mr. James N. Douglas for the details of its construction. I will now, with your permission, put the siren into operation; and although you may perhaps find the sound overpowering, you will, I know, be glad to bear any amount of inconvenience in the cause of humanity; and I think you will be interested in having practical proof of its power. Not having steam at hand, I propose to sound it on this occasion by air compressed by a gas engine, which, with the kind permission of Dr. Steele and Professor Moss, I have placed in the laboratory yard behind this lecture-room. I may remark *en passant* that this is another example of the flexibility of gas, for at stations where gas is employed the siren could be sounded at a moment's notice, while if either steam or compressed air be used much precious time, during which vessels might run into danger, must be lost in getting up the necessary heat.

To return once more, before concluding, to the painstaking investigations of the Trinity House. A fourth Parliamentary paper describes their experiments with guns, in which they were again aided by Dr. Tyndall. These experiments were undertaken in consequence of the results at South Foreland having proved the efficiency of guns as fog signals. The various trials were made at the gun factory, Woolwich, by the War Department, who appear to have entered upon the investigation with most praiseworthy zeal, all the more gratifying as that department is generally engaged in devising and constructing the means for destroying human life, and not for saving it. Many trials of many guns were made, and ultimately the form shown in this diagram was adopted as the best sound producer. It is a five-chambered revolver, easy to load and easy to fire (Fig. 7).

Fig. 7.



Some years ago it occurred to me that gas guns might be made

available as fog signals, and trials were made with good effect at Howth Bailey Lighthouse. The noise produced was about the same as an 18-pounder gun, while the flash was considered brighter. The gun is simply an iron tube, fifteen inches in diameter, and twelve feet long, closed at one end. Gaseous cartridges, consisting of a mixture of coal gas, air, and oxygen, are delivered into the gun from small gas-holders, and fired by ordinary friction tubes or percussion. The gas-guns may be placed at the water's edge, and loaded and fired by the light-keeper without his leaving the lighthouse. I have here a miniature gas-gun, consisting of a one-inch tube, about four feet long, and will fire it in order that you may have some idea of the power of the full-sized gun. Gun-cotton discs have also been tried by the Trinity House with such good effect that they have issued notices to mariners that a gun-cotton signal station has been established at Heligoland. The discs are simply suspended with thin cords, in the manner shown in this diagram. If fixed by any substantial framing, the result would probably be that the explosion would cause the destruction of the framing, and perhaps serious damage to the lighthouse.

Gun-cotton rockets are also excellent fog signals, and are at present the subject of investigation by the Elder Brethren and Dr. Tyndall. It is impossible now to go into the details of all the interesting experiments which have been made with these various means of fog signalling, nor can I venture to touch upon the important subject of telegraphy by sound. They would each form in themselves subject for an evening's lecture. I have detained you too long, and my apology is that the welfare of those that "go down to the sea in ships," that "do business in great waters," that there "see the works of the Lord and His wonders in the deep," much concerns everyone of us, especially when we remember that, though perchance their soul is at times "melted" because of the dangers which they encounter, yet still in spite of all difficulties they go on, through fog and snow, storm and darkness, pursuing their arduous occupation, while we on shore, comfortably living at home, gain through their lives of hardship and privation nearly all the luxuries we enjoy. Believing that this feeling animates us all, I have ventured at such length to bring before you some of the means devised for the benefit of a class of men with whose prosperity, as it seems to me, our very civilization is connected.

INTELLIGENCE.

EVENING SCIENTIFIC MEETINGS.

Monday Evening, Nov. 16, 1874.

John Adair, A.M., in the Chair.

Mr. James Lynam, C.E., made a communication on the proposed Shannon Drainage.

The reading of the paper, which was illustrated by wooden models, was followed by a discussion, in which the Chief Secretary for Ireland took part.

December 21, 1875.

Professor M'Nab in the Chair.

Professor Macalister delivered a discourse on Rudimentary and Provisional Organs.

January 18, 1875.

Howard Grubb, C.E., in the Chair.

Professor Cameron read a Paper "On Milk."

M. J. Angelo Fahie read a Paper on the Patent Laws.

Professor C. R. C. Tichborne read a communication on the Rational Estimation of Nitrogen in Manures.

March 1, 1875.

Robert S. Ball, LL.D., in the Chair.

Chichester A. Bell, M.D., made a communication on the Constitution of Benzol.

Professor J. E. Reynolds read a Paper on the Estimation of Chlorides in Well or in River Water.

Monday, March 15, 1877.

John Adair, A.M., in the Chair.

Mr. W. F. Kirby, Assistant Naturalist in the Museum, read a communication on the Colorado or Potato Beetle of North America.

Mr. Richard Jackson Moss read a Paper on Selenium.

Dr. Edward L. Moss, R.N., exhibited specimens of the *Osteocella Septentrionalis* which he presented to the Society for the Museum.

Tuesday, April 20, 1877.

Mr. William Harold in the Chair.

Thomas Grubb, F.R.S., read a Paper on the Economical Consumption of Coal Gas.

Mr. R. J. Moss read a Paper on Cobalt-Chloride as a Test for Moisture.

A fine prepared specimen of a Gorilla, recently purchased for the Museum, was exhibited.

Monday, May 24, 1875.

George Woods Maunsell, A.M., D.L., Vice-President, in the Chair.

Mr. Henry Sidford, M.R.A.S., delivered an interesting discourse on the Social Life of the Chinese, illustrated by a large collection of figures, which he presented to the Society.

MONDAY, NOV. 15, 1875.

ROBERT S. BALL, LL.D., F.R.S., Astronomer Royal for Ireland, in the Chair.

Mr. J. ANGELO FAHIE read a Paper on the Rhea Fibre and its Mechanical Treatment.

MONDAY, DECEMBER 20, 1875.

REV. PROF. HAUGHTON, M.D., F.R.S., in the Chair.

ROBERT S. BALL, LL.D., F.R.S., Astronomer Royal, delivered a discourse on the Transit of Venus.

MONDAY, JANUARY 17, 1876.

MAURICE BROOKS, M.P., in the Chair.

Mr. CHARLES DAWSON read a communication on the Dwellings of the Labouring Classes.

MONDAY, FEBRUARY 21, 1876.

EDWARD DILLON MAPOTHER, M.D., in the Chair.

RICHARD JACKSON MOSS, F.C.S., Keeper of the Minerals and Analyst, Royal Dublin Society, delivered a discourse on Spectroscopic Research.

MONDAY, MARCH 20, 1876.

PROFESSOR REYNOLDS in the Chair.

PROF. W. F. BARRETT, F.R.S.E, read a Paper on Crookes' Radiometer.

RICHARD J. MOSS, F.C.S., Keeper of the Minerals, made some observations on Minerals lately added to the Society's collection.

TUESDAY, APRIL 25, 1876.

W. H. MACKINTOSH, A.B., delivered a discourse on the Microscopic Structure of the Spines of the Sea Urchins.

MONDAY, MAY 15, 1876.

JOHN ADAIR, A.M., in the Chair.

Mr. THOMAS A. DILLON read a Paper on the new System for Recording Deeds adopted by the Treasury.

Mr. DILLON also explained and demonstrated his Method for Raising Sunken Ships.

MONDAY, NOVEMBER 2, 1876.

Mr. J. RAWSON CARROLL in the Chair.

Mr. M. ANGELO HAYES read a Paper on the Pictorial Representation of Animals in Rapid Motion.

R. J. MOSS, F.C.S., Keeper of the Minerals and Analyst, Royal Dublin Society, read a Paper on the collection of Fossil Bones, chiefly of the Elk (*cervus megaceros*), found at Ballybetagh, co. Dublin.

Ornithological and Ethnological specimens collected by Dr. W. H. GOOD, R.N., in the Islands of the Pacific, and presented by him to the Society, were exhibited.

C. R. C. TICHBOURNE, PH.D., F.C.S., exhibited specimens of Magnetic Iron Ore from the co. Wicklow.

MONDAY, DECEMBER 18, 1876.

PROFESSOR J. EMERSON REYNOLDS, M.D., in the Chair.

CHARLES R. C. TICHBOURNE, PH.D., F.C.S., delivered a discourse on Coal Gas and its Applications to House Lighting.

MONDAY, JANUARY 15, 1877.

REV. PROF. HAUGHTON, M.D., F.R.S., in the Chair.

DR. EDWARD L. MOSS, R.N., one of the Medical Officers of the Arctic Expedition, delivered a discourse on the late Arctic Expedition. A valuable collection of specimens and articles in illustration of the discourse was at the same time exhibited, and since presented to the Society.

MONDAY, FEBRUARY 19, 1877.

ROBERT S. BALL, LL.D., F.R.S., Astronomer Royal, in the Chair.

The following Papers were read:—

CHARLES A. CAMERON, M.D., City Analyst, and Prof. Chem. Royal Coll. Surg., Ireland,—On a material impervious to moisture for the manufacture of bricks for damp courses.

JAMES EMERSON REYNOLDS, M.D., F.C.S., Professor of Chemistry, University of Dublin.—On a new form of measuring apparatus for a Laboratory Spectroscope.

HOWARD GRUBB, F.R.A.S.—On Great Telescopes of the future.

GEORGE JOHNSTONE STONEY, M.A., F.R.S., Secretary Royal Dublin Society.—On an analogy between motions within the molecules of Gases and the motions of particular acoustic arrangements.

A fine specimen of the Proboscis Monkey, from Borneo, was exhibited.

MARCH 19, 1877.

EARL OF ROSSE, F.R.S., in the Chair.

The following Communications were read:—

PROFESSOR EDWARD HULL, M.A., F.R.S., Director of the Geological Survey of Ireland.—On the origin and geological age of "the Scalp," on the borders of Wicklow and Dublin.

PROFESSOR J. EMERSON REYNOLDS, M.D., F.R.S., Professor of Chemistry, University of Dublin.—On the estimation of combined Nitrogen in certain animal fluids.

GEORGE JOHNSTONE STONEY, M.A., F.R.S., Secretary Royal Dublin Society.—On the velocity of light of different refrangibilities in Stellar space.

APRIL 16, 1877.

RIGHT HON. THE EARL OF ROSSE, F.R.S., in the Chair.

A Discourse was delivered by Mr. JOHN R. WIGHAM on Marine Fog signalling. This discourse was copiously illustrated by apparatus and experiments, conducted on an unusually large scale.

MONDAY, MAY 21, 1877.

PROFESSOR J. EMERSON REYNOLDS, M.D., in the Chair.

THE RIGHT HON. EARL OF ROSSE, F.R.S.—Preliminary note on some measurements of the Polarization of Light coming from the Moon and from the Planet Venus. Read by Mr. STONEY, Secretary.

WILLIAM ANDREWS, Esq.—Notes on the Crustacea of Ireland.

JOHN SMITH, Esq., F.C.S.—On the Substitution of an Alkaline base in Chlorimetry.

R. JACKSON MOSS, F.C.S., Keeper of the Minerals and Analyst, Royal Dublin Society.—On a Specimen of Quartz with pearl-lustre.

EDWARD HULL, A.M., F.R.S., Director of the Geological Survey, and Professor of Geology, Royal College of Science, Ireland.—An account of successive attempts to obtain water by deep wells under London.

J. EMERSON REYNOLDS, M.D., Professor of Chemistry, University of Dublin.—On a remarkable action of light on certain organo-metallic bodies.

G. JOHNSTONE STONEY, M.A., F.R.S., Secretary Royal Dublin Society.—On the Penetration of Heat across Crookes's layer.

AFTERNOON SCIENTIFIC LECTURES were delivered in 1877, as follows:—

JANUARY 29.

T. RUPERT JONES, F.R.S., F.G.S., Prof. of Geology, Royal Military and Staff College, Sandhurst.—On the Antiquity of Man.

FEBRUARY 7.

W. F. BARRETT, F.R.S., F.C.S., Prof. of Physics, Royal College of Science, Ireland.—On the Analogy of Light and Sound.

FEBRUARY 14.

EDWARD HULL, A.M., F.R.S., Director of the Geological Survey of Ireland.—On the Origin of the Physical Features of Ireland.

FEBRUARY 21.

RICH. JACKSON MOSS, F.C.S., Keeper of the Minerals and Analyst, R.D.S.—On Fermentation.

FEBRUARY 28.

W. RAMSAY M'NAB, M.B., Professor of Botany, Royal College of Science, Ireland.—On Mr. Darwin's Contributions to Botany: Cross Fertilization, Carnivorous and Climbing Plants.

MARCH 7.

J. EMERSON REYNOLDS, M.D., F.C.S., Professor of Chemistry, Univ. of Dublin.—An Experimental Study of Two Gases.

MARCH 14.

ALEXANDER MACALISTER, M.D. Professor of Comparative Anatomy and Zoology, Univ. of Dublin, and of Artistic Anatomy, Royal Dublin Society.—On the Mutual Relation of the Organs of Special Sense.

MARCH 21.

ROBERT HARKNESS, F.R.S., F.G.S., Professor of Mineralogy and Geology, Queen's Coll., Cork.—On the Laurentian Rocks: their Representation in Great Britain and Europe, and the Deposits which overlie them.

Donations to the Royal Dublin Society.

LIBRARY.

The GOVERNMENT of SOUTH AUSTRALIA, Adelaide.
Adelaide Almanac and South Australian Directory (Boothby's) for 1873. Adelaide, 1873.

The AUTHOR, Provost's House.
Treatise on the Wave Theory of Light. By H. Lloyd, D.D., Provost of T.C.D. Third Edition. London, 1873.

The AUTHOR, 7, Bond-street, Manchester.
Experiments on the Oxidation of Iron. By Dr. F. Crace Calvert. Manchester, 1872.
Dr. F. Crace Calvert on Protoplasmic Life. Manchester, 1873.

The AUTHOR, College of St. Patrick, Maynooth.
Geology and Revelation. By the Rev. Gerald Molloy, D.D., Second Edition. London, 1873.

The LIBRARIAN of TRINITY COLLEGE. By Henry Dix Hutton, Esq.
Catalogue of the Library, T.C.D. Vol. I. A—B. Dublin, 1864.

Mr. THOMAS BEANY, Church Gate-house, Drumcondra.
Shall we alter the Ordinal? By Rev. C. P. Reichel. Dublin, 1872.
Speeches of Dr. Reichel and the Provost, T.C.D., on Revision. Dublin, 1872.

HENRY DIX HUTTON, Esq., 10, Belfast-terrace, North Circular-road.
Fribourg. L'Association Internationale du Travailleurs. Paris, 1871.
Thaer. Die Wirthschafts Direction des Landgates. Berlin, 1861.
Festschrift fur die 25 Versammlung deutscher Land-und Forstwirthe zu Dresden, 1865. Dresden, *s.a.*
Judeich. Die Grundentlastung in Deutschland. Leipzig, 1863.
Amtlicher Bericht über die 25 Versammlung deutscher Land- und Forstwirthe, 1865. Dresden, 1866.
Judeich. Die Landrentenbank im Konigreiche Sachsen. Leipzig, 1866.
Testut. L'Internationale. Paris, 1871.
Lanjalley et Coriez. Histoire de la Revolution du 18 Mars. Paris, 1871.
Le Paysan. Par F. de Lasteyrie. Paris, 1869.
La Commune, 1871. Par L. Le Chevalier. Paris, 1871.

HENRY DIX HUTTON, Esq., 10, Belfast-terrace, North Circular-road.
Henryot. Paris pendant le Siege, 1870–1871. Paris, 1871.
Troisième Proces de l'Association Internationale. Paris, 1870.
Malon. Écoles socialistiques. Paris, 1870.
Bulletin des Lois de la Commune de Paris. Paris, 1871.
Stark. Die Degeneration des Französischen Volkes. Stuttgart, 1871.
Richardet. Quatre jours de Prison sous la Commune. Paris, 1871.
Les cités Ouvrières du Havre, 1871. *s.l., s.a.*
La Commune devant le Conseil de Guerre. 5 Ser. Paris, 1871.
Lockroy. La Commune et l'Assemblée. Paris, 1871.
Königl. Sächsische Landescultur-Gesetze. Leipzig, 1871.
Landes-Oeconomie-Gesetzbung des Königreichs Hannover. Hannover, 1846.

HENRY ALLEN, Esq.
Alanus. Observationes in Frontini Strategematica. Dublin, 1873.
Codicum Suetonii specimen necnon Observationes Alani. Dublin, 1873.

HENRY DIX HUTTON, Esq., 10, Belfast-terrace, North Circular-road.
Joigneaux. Lettres aux Paysans. Paris, 1871.
Écoles de la Ville du Havre. Havre, 1871.
Hanseen zur Geschichte der Feldsysteme in Deutschland. Tübingen, 1865.
International Resolutions at Brussels, 1866, and Geneva, 1868. London, *s.a.*
Rapport de l'Organisation des Écoles du Havre. Havre, 1871.
Thaer. Ueber die Stellung der Tagelöhner. Berlin, 1865.
Proces de l'Internationalle. 2ième edit. Paris, 1870.

Mrs. WILLS, 35, Wellington-road.
Antecedent Probability of the Christian Religion. By James Wills, D.D. Dublin, 1860.
The Idolatress, and other Poems. By James Wills, D.D. London, 1868.

HENRY DIX HUTTON, Esq., 10, Belfast-terrace, North Circular-road.
Annalen der Landwirthschaft. Band 49. Berlin, 1867.

Mr. H. J. FENNELL, College of Physicians, Kildare-street.
Woods on Pulmonary Consumption. Parsonstown, 1847.
List of Licentiate Apothecaries of Ireland. Dublin, 1872.

BRITISH ASSOCIATION, GEORGE GRIFFITH, Esq., Assistant-General Secretary, 22, Albemarle-street, London, W.
Report of the Forty-second Meeting of the British Association, at Brighton, August, 1872. London, 1873.

HENRY DIX HUTTON, Esq., 10, Belfast-terrace, North Circular-road.
Thur-und Neumarkiches . . . Ritterschafts-credit-Reglement. Berlin, 1777-84, 1847-67.

National Association for Promotion of Social Science; Office, 1, Adam-street, Adelphi, London, W.C.
Transactions, National Association for Promotion of Social Science, Leeds Meeting, 1871. London, 1872.
Plymouth and Devonport Meeting, 1872. London, 1873.

The Author, 15, Fenchurch Buildings, London, E.C.
Papers on Maritime Legislation. Second Edition. By Ernst Emil Wendt. London, 1871.

The Orator, 5, College.
Address to College Historical Society, November 13, 1872. By Abraham Stoker, A.B., Auditor. Dublin, 1873.

Lords of the Treasury, by Right Hon. Sir William Gibson-Craig, Bart., Lord Clerk Register of Scotland, Register Office, Edinburgh.
Facsimiles of National Manuscripts of Scotland. By Col. Sir Henry James, R.E. Part III. Edinburgh, 1872.

From the Author, Drummin House, Carbury, co. Kildare.
Considerations of the Human Mind, its present State, and future Destination. By Richard Grattan, Esq. M.D. London, 1861.
The Right to Think: addressed to the Young Men of Great Britain and Ireland. London, 1865.
Law Reform.—Reddin against Grattan, and Coyne against Grattan. Dublin, 1873.

From Commander W. H. Symons, R.N., Secretary of the Society, Office, Hibernia Chambers, London Bridge, London, S.E.
Twenty-fourth Annual Report of the Shipwrecked Fishermen and Mariners' Royal Benevolent Society. London, 1873.

Capt. S. P. Oliver, Royal Artillery, Buncrana, co. of Donegal.
Nurraghi-Sardi and other Stone Buildings of the Mediterranean Basin.

Colonel Lake, Dublin Castle.
Statistical Tables of the Dublin Metropolitan Police for 1875.

Philip H. Bagenal, 73, Lower Baggot-street.
Compendium of Loan Acts.

The Lords Commissioners of the Admiralty.
Manual and Instructions for the Arctic Expedition.

John Maunsell, Constabulary Office, Dublin Castle.
Constabulary List, for half-year commencing 1st July, 1875.

Denis H. Kelly, Arraghty Grange, Athleague, co. of Roscommon
The Book of Fenagh.

W. S. Keogh, 40, Lower Baggot-street.
Ireland, Sixty Years Ago.
Col. Adair's Established Church of Ireland; and Servile War.
Bert's Livre de Famille.

J. G. Keogh, Roundwood House, co. of Wicklow.
Illustrated London News for 1864–5.

Sir Redmond Barry, Carlton Gardens, Melbourne, Australia.
Report of the Trustees of the Public Libraries, Museums, &c. of Victoria for 1874–5.

E. H. Von Bamhaus, Secrétaire Perpetuel Société des Sciences à Harlem.
Archives Néerlandaises. Vol. 10; Livraisons 1, 2, 3.
Programme pour l'Anneé 1875.

P. E. Bagenal, 73, Lower Baggot-street.
Disjointed jottings, by "*Nat Naylor*."

Wm. Lane Joynt, d.l. Crown and Treasury Solicitor, 46, Lower Gardiner-street.
Report of the Case of the Queen *v.* Castro.

J. F. Waller, ll.d., Vice-President, Royal Dublin Society.
Le Mobacher, Planisphère céleste des Arabes.

Chief Secretary, Adelaide.
Statistical Register for 1874, South Australia.

Registrar-General, Brisbane.
Fourteenth Annual Report on Vital Statistics of Queensland.

The Author, S. O. Lindborg, Helsingfors, Finmark.
Hepaticæ in Hibernia mense Julii 1873 lectæ.

Secretary, Census Office, Wellington, New Zealand.
Results of a Census of the Colony of New Zealand, &c.

J. H. de Ricci.
Fiji.

Rev. James Graves, Kilkenny.
Church and Shrine of St. Manchan.

Admiral Spratt, Tonbridge Wells, Kent.
Travels in Crete.

George Eason, 30, Kenilworth-square, Rathgar.
Almanac and Handbook for Ireland, 1875.

Rev. W. G. Carroll, 27, Wellington-road.
Memoir of Dr. O'Brien late Bishop of Ossory.

C. Holst, Secretary, Royal University, Christiania, Norway.
Eight Publications relating to the Fauna and Flora of Norway.

Mr. Tully, Mount Bellew, co. of Galway.
Two rare Coins.

Reverend S. Haughton, m.d., Trinity College, Dublin.
Vols. 1, 2, 3, & 4 of the Journal of the Royal Geological Society of Ireland.

Major Blayney Walshe, Oatlands, Builth, Radnorshire.
Sporting and Military Adventures in Nepaul and the Himalayas.

JACOB ENNIS, care of Messrs. Trübner and Co., 57, Ludgate Hill.
Origin of the Stars.

E. STAMER O'GRADY, 105, Stephen's-green, South.
Clinical Records of Surgical Cases.

The ASTRONOMER ROYAL, Observatory, Greenwich, London, S.E.
Greenwich Observations for 1873.

W. S. KEOGH, 40, Lower Baggot-street.
Finn's Jews in China.
The Inquisition.

REGISTRAR-GENERAL, Brisbane, Queensland.
Blue Book for 1874.

WILLIAM WHITE, Statistical Society, London.
Insurance Register for 1875.

GERALD GRIFFIN, 10, South Frederick-street.
Philosophy of Literature.

ALFRED MORGAN, Honorary Secretary Literary and Philosophical Society of Liverpool.
Twenty-ninth Volume of Proceedings.

W. RICHARDS, Publisher, 7, Catherine-street, Strand, London, W.C.
Agricultural Gazette Almanac for 1875.

The REGISTRAR-GENERAL, Dublin.
Quarterly Return of Births, Marriages, and Deaths.

Reverend J. A. MALET, Librarian, Trinity College.
Vols. 14 and 17 of Usher's Works.

EDWARD SANG, Secretary, 2, George-street, Edinburgh.
Parts 5 of Vol. 8, and 1 & 2 of Vol. 9, of Transactions of the Royal Scottish Society of Arts.

J. F. MEADE, Trinity College, Dublin.
The Athanasian Creed and Legislation thereon.

ROYAL ASTRONOMICAL SOCIETY, Burlington House, London.
Vol. 42 of the Memoirs of the Royal Astronomical Society.

SOCIÉTÉ ROYALE des SCIENCES à UPSAL, Suède.
Nova Acta Reg. Soc. Sc. Upsal. Ser. 3, Vol. 9, Fascic. 2. Et Bulletin Météorologique, Vol. 6.

A. H. JACOB, M.D., 79, Harcourt-street.
Historical and Genealogical Narrative of the Families of Jacob.

The Reverend ROBERT WM. BUCKLEY, 44, Rathgar-road.
Metrical Translations and Lyrics.

The LIBRARIAN, Royal Academy of Sciences, Stockholm.
Mémoirs, Vols. 9 (Part 2), 10 and 12. Supplement to Memoirs. Vol. 1, Parts 1–2, Vol. 2, Parts 1–2. Biographical Notices Vol. 1, Part 3.

The DIRECTORS, Musée Teyler, Harlem, Holland.
Archives du Musée Teyler. Vol. 1, Fasc. 1; Vol. 4, Fasc. 1.

E. H. VON BAUMHAUS, Secrétaire Perpétuel, Société, Hollandaise des Sciences, Harlem.
Naturkundige Verhandelingen 3. Serie T, 2–5.
Archives Néerlandaises. T. 10, 4, 5; T. 11, 1.
Programme pour l'Année.

HUBERT J. DE BURGH, care of Mr. Ponsonby, 116, Grafton-street.
The Rose, the Shamrock, and the Thistle. Speeches delivered in Quebec and Toronto, 1841–2.

Le SECRÉTAIRE GÉNÉRAL, Académie Royale des Sciences, Amsterdam.
Verslagen en Mededeelingen, Afd. Naturkunde Jaarbock, 1874.
Proces-Verbaal, 1874–5.

The Reverend W. G. CARROLL, 27, Wellington-road.
Memoir of the late Bishop of Ossory and Ferns.
Bishop Clayton on the Nicene and Athanasian Creeds.

JAMES HECTOR, M.D., F.R.S., F.G.S., Director, Colonial Museum, Wellington, New Zealand.
Tenth Annual Report of the Colonial Museum and Laboratory.

Le SECRÉTAIRE PERPÉTUEL, Académie Royale des Sciences, etc., à Bruxelles.
Bulletins de l'Académie, 2e Série. Tomes 37, 38, 39, 40.
Annuaire de 1875–1876.

The REGISTRAR-GENERAL, Brisbane, Queensland.
Fifteenth Annual Report of Vital Statistics.

CHARLES and EDWIN LAYTON, Fleet-street, London.
Financial Register and Stock Exchange Manual.

GEORGE WOODS MAUNSELL, Esq., Vice-President.
A set of the *Dublin Evening Mail* and of the *Dublin Evening Post* from the commencement, bound.

The SECRETARY, Institution of Civil Engineers, 25, Great George-street, Westminster, S.W.
Minutes of Proceedings, Vol. 43, Sess. 1875–6, Part 1.

The CHIEF SECRETARY, Adelaide, South Australia.
Statistical Sketch of South Australia by Josiah Booth, Esq.
South Australia, its History, Resources, and Productions, by William Harcus, Esq.

J. R. GARSTIN, Greenhill, Killiney.
Facts and Reasonings in support of the course taken by the R. I. Academy.

WILLIAM M'MECHAN, St. John's, Sandymount.
Pamphlet on the Sunday Closing Bill.

The SECRETARY, Institution of Civil Engineers, 25, Great George-street, Westminster, London, S.W.
Minutes of Proceedings of the Institution of Civil Engineers.

The SECRETARY, New Zealand Institute, Wellington, New Zealand.
Transactions and Proceedings of the New Zealand Institute, Vol. 8.

W. C. THOMPSON, 41, Moorgate-street, London, E.C.
Handbook of the Union and Central Pacific Railways.

J. T. BUTLER, R.M., Castlecomer, Kilkenny.
The Caswell Case.

W. S. KEOGH, 77, Lower Leeson-street.
The Trial of Sir Jasper.

The REGISTRAR-GENERAL, Brisbane, Queensland.
Queensland Blue Book for the Year 1875.

WILLIAM HARCUS, care of Messrs. Sampson, Low, Marston, &c., Crown Buildings, 188, Fleet-street, London.
South Australia, its History, Resources, and Productions.

R. H. M. BOSANQUET, M.A., F.R.S., Fellow of St. John's College, Oxford.
On a New Form of Polariscope.

The COUNCIL, ROYAL COLLEGE of SURGEONS of ENGLAND, Lincoln's Inn Fields, London W.C.
Calendar for 1876.

H. READER LACK, Clerk of the Commissioners of Patents, 39, Cursitor-street, London.
Alphabetical and Subject-matter Indexes for 1871, 2, 3, 4 and 5.

RICHARD GIBBS, Registrar-General, Melbourne, Victoria.
Abstracts of Specifications of Patents. Metals, Part 2, Section 1.

Madame MAS, Bourg-en-Bresse, Ain, France.
Notice sur Alphonse Mas, Chevalier de la Legion d'Honneur, &c.

J. F. HODGES, Esq., M.D., Belfast.
Presidential Addresses, Belfast Natural History and Philosophical Society. Nov. 10th, 1875, and Nov. 8th, 1876.

W. RICHARDS, 7, Catherine-street, Strand, London, W.C.
The Agricultural Gazette Almanac for 1877.

CHARLES EASON. W. H. Smith & Sons, Middle Abbey-street.
Eason's Handbook and Almanac for Ireland for 1877.

CHARLES A. CAMERON, M.D., 15, Pembroke-road.
Short Poems translated from the German.

HENRY JORDAN, Registrar-General, Brisbane, Queensland.
One Copy of Vital Statistics of Queensland.

Sir DENHAM JEPHSON NORREYS, Mallow Castle, Mallow.
Report of the State of the District around Mallow.

J. O. HALLIWELL PHILLIPPS, 11, Tregunter-road, West Brompton, London.
Illustrations of the Life of Shakespeare. Part the First.

Mrs. MARIE A. IDEEN, Philadelphia, U. S. America.
A centennial Call to all Nations.

A. LIVERSIDGE, the University, Sydney, N. S. W., Australia.
Mineral Map and General Statistics of New South Wales.

HENRY C. WATSON, Thames Ditton, Kingston, Surrey (through A. G. MORE, R. D. S.)
Topographical Botany, Parts 1 and 2.

G. N. PLUNKETT, Palmerston-road, Rathmines.
God's chosen Festival and other Poems.

HENRY JORDAN, Registrar-General, Brisbane, Queensland.
A copy of the Statistical Register of Queensland for 1876.

W. G. BLACKIE, Local Secretary, British Association, Glasgow, 17, Stanhope-street, Glasgow.
Principal Manufactures of the West of Scotland.
Fauna and Flora of the West of Scotland.
Catalogue of Western Scottish Fossils.

The CHIEF SECRETARY, Adelaide, South Australia.
Statistical Register for South Australia for 1875.

MUSEUM OF NATURAL HISTORY.

J. T. BUTLER, Esq., R.M., Castlecomer.
A fine and perfect specimen of the fossil Reptile *Keraterpeton Galvani*, from the coal mines at Castlecomer.

Rev. Dr. M'ILWAINE, Ulsterville, Belfast.
A fine Crystal of Epidote.

His Grace the Duke of LEINSTER.
A ringed snake from England (*Tropidonotus torquatus*).

J. G. ROBERTSON, Esq., Prior's Orchard, Kilkenny.
An Earthenware Ibis mummy-case, from Cairo, and an African shield made of Palm leaves.

H. BURNLEY RATHBORNE, Esq., Dunsinea.
A variety of the Starling *Sturnus vulgaris*.

Dr. E. L. MOSS, R.N.
Three specimens of the rare Zoophyte, *Osteocella septentrionalis*, from Vancouver's Island.

Miss WALLER, 63, Wellington-road.
Some Irish Zoophytes, and fine specimens of a sponge, *Chalina oculata*, collected at Cahore, Waterford.

H. ÆNEAS SIDFORD, Esq., M.R.A.S., Imperial Chinese Civil Service, 17, Nassau-street.

A series of coloured Chinese figures showing the costumes of various classes of society, and the theatrical dresses used in China.

T. FITZHERBERT, Esq., Blackcastle, Navan.

Two abnormal specimens of salmon fry, showing the twin young fish united.

ROBERT WARREN, Moyview, Ballina.

A female pied Flycatcher, *Muscicapa atricapilla*, shot at Moyview, April 19, 1875, this being the first instance of the bird occurring in Ireland.

A black Guillemot, a Greenshank, a Knot, a Redshank, and a Bartailed Godwit, all obtained in the Moy estuary.

J. G. ROBERTSON, Esq., Prior's Orchard, Kilkenny.

A Chinese Pig-tail and an ancient Egyptian Mirror.

Mrs. ROGERSON, Ottawa, New Zealand.

A few Birds' skins from New Zealand.

Mr. JOSEPH S. TREVOR, Library Assistant, Royal Dublin Society.

A fine male specimen of the Black Rat (*Mus rattus*), now very rare in Ireland.

R. N. GREENE, Esq., Rosemount, Drumcondra.

A shield made of hide from Natal.

R. P. WILLIAMS, Esq., 38, Dame-street.

A Sandwich Island Goose which had lived in his aviary at Clontarf.

Captain BOLTON FALCONER, through John Rigby, Esq., 24, Suffolk-street.

A male Lion shot in Algeria. (Deposited.)

Dr. CHURCHILL, 15, Stephen's-green.

Two Chinese Mirrors made of polished metal and a Flying Fish.

Dr. J. B. GAFFNEY, Port Royal, Ballinrobe.

An Andamanese skull painted and scored, having been worn as an ornament.

J. D. OGILBY, Esq.

Two Kingfishers from co. Tyrone.

R. J. USSHER, J.P., Cappagh, Cappoquin.

A white-winged Black Tern (*Hydrochelidon leucoptera*), shot at Cappagh, co. Waterford, on the 13th of May, 1875.

Captain A. P. ALLEN, 30, Northumberland-road.

A suit of armour made of platted cord, and ten arrows from the South Sea Islands.

Miss CRANFIELD, 26, Lansdowne-road.

Three paintings on talc from India.

John O'Connell, Esq., 2, Scott's-square, Queenstown.
An Albatross (*Diomedea exulans*).

Edward Watson, Esq., 15, Eden-quay.
A large specimen of the Gar-fish (*Belone vulgaris*).

N. J. Murphy, Esq., 74, Upper Gardiner-street.
Two Nulla-nullas, a water basket, a shield, three bags, a boomerang, and a chain made of shells from Queensland.

John Riall, Esq., Heywood, Clonmel.
A variety of the Partridge (*Perdix communis*).

W. Somerset Keogh, Esq., Library R.D.S.
An Irish Pike-head which was used in the rising of 1848.

Miss Kenny, Kilkenny-street, Castlecomer.
Two fossil fish-spines (*Gyracanthus formosus*), from the coal mines at Castlecomer.

J. T. Butler, Esq., R.M., Castlecomer, Kilkenny.
Two fine specimens of the fossil Reptiles (*Urocordylus, Wandesfordi*, and *Dolichosoma, Emersoni*), from the coal formation at Castlecomer.

W. K. Dover, Esq., Castleconnor, near Ballina.
Nine specimens of Graptolites from the Skiddaw Slate, Lower Silurian.

Dr. Battersby, Lough Carra, Killarney.
A number of recent Mediterranean shells collected by himself in Corsica.

R. M. Barrington, Esq., Fassaroe, Bray.
Two female specimens of the Hairy-armed Bat, *Scotophilus Leisleri*, from Tandragee, Armagh.

Captain C. C. Clayton, 34th Regiment.
A few Scorpions, Snakes, and Lizards from India.

Dr. M'Clintock, 21, Merrion-square.
A stone sacrificing block and knife used in Hindoo worship.

Dr. Twiss, Ballinrobe.
A pied variety of the Rook (*Corvus frugilegus*).

Master H. R. Huband, 39, Upper Mount-street.
Two Assagai heads.
One Chinese box covered with silk.
One small Tray and a Pincushion from Canada.

Alonzo G. Grant, Esq., 7, Gilford-road, Sandymount.
The skull of a large Alligator, which measured 17 feet 3 inches, shot by himself in the river Oklawaha, Florida.

Rev. A. M. Norman, Durham.
Three rare shells, viz., *Panopœa Norvegica, Fusus Bernicensis, Fusus Norvegicus*, from the Dogger Bank

Mrs. Battersby, Cromlyn, Rathowen, Westmeath.
Some eggs of native birds and a few Lepidoptera.

D. T. Seymour, Esq., Commissioner of Police, Brisbane, Queensland.
A very fine and large specimen of the Australian Cassowary (*Casuarius Australis*).

J. G. Robertson, Esq., Prior's Orchard, Kilkenny.
A Nubian shield made of Crocodile's skin, and a slave-driver's whip.

W. Corbet, Esq., Castleconnell.
A military red-breasted Lark, *Sturnella militaris*.

Rev. J. H. Griffith, Drumcliff Glebe, Sligo.
An immature Skua or Robber Gull (*Lestris Richardsonii*).

Mrs. Hungerford Eager, 51, Upper Mount-street.
A specimen of the Duck-billed Platypus (*Ornithorhynchus paradoxus*).

Right Hon. Lord Powerscourt.
A large Dog, stuffed; supposed to be a hybrid between dog and wolf.
Two black-necked Swans from South America; and
A Canadian Canoe made of bark.

J. C. Vigors, Esq.
A very large and fine *Turbo*, from Carteret Harbour, New Ireland.

James Clibborn, Esq., Woodville, Sandford-road.
Five Arrows from South America.

John Rocke, Esq., Clungunford House, Shropshire.
A specimen of the Grayling (*Thymallus vulgaris*), taken in the River Clun, Shropshire.

Wilton Oldham, LL.D., Ghazepore, India.
The skin of a Gavial (*Gavialis gangeticus*).

G. H. Kinahan, Esq., Geological Survey of Ireland.
A Buzzard (*Buteo vulgaris*), shot by himself near Wexford.

Captain W. K. Dover.
An Avocet (*Recurvirostra Avocetta*), shot by himself on the Estuary of the Moy, near Moy-view.

J. Douglas Ogilby, 36, Elgin-road.
Some rare Irish Fishes, captured near Portrush, including, Yarrell's Blenny (*Blenniops Ascanii*); the Gattoruginous Blenny (*B. Gattorugine*), &c.

Royal Irish Academy.
A number of bones of Mammoth (*Elephas primigenius*); Rein Deer (*Tarandus rangifer*); Horse (*Equus caballus*); Red Deer (*Cervus elaphus*), &c., collected by Dr. A. Leith Adams in the course of exploring a cave at Shandon.

W. H. Mayne, Esq., 10, Vesey-place, Kingstown.
A few Birds' skins from Australia and Brazil.

ALFRED MALONE, Esq., 3, St. James's-terrace, Clonskeagh.
Silicified wood from Cairo.

Hon. E. O. MACDEVITT, 8, Fitzgibbon-street.
A few minerals from Queensland, and a Photograph of the nest of Bower Birds.

RICHARD J. USSHER, J.P., Cappagh, Cappoquin, Waterford.
A number of Bones of *Megaceros Hibernicus.*

ROYAL SOCIETY, London, through Trustees of British Museum.
A number of Bones of the extinct Bird, the Solitaire (*Pezophaps solitarius*), from Rodriguez; also a few specimens of Shells, Insects, *Crustacea*, Fish, &c., collected by the Naturalists attached to the Transit of Venus Expedition.

Dr. ST. LAWRENCE MULLEN, R.N., H.M.S. "Excellent," Portsmouth.
A model of a double canoe, spears, clubs, &c., from the Islands of Polynesia.

H. J. FENNELL, Esq., Librarian, King and Queen's College of Physicians.
Ten Chinese Coins.

R. P. WILLIAMS, Esq., 36, Dame-street.
A male Cereopsis Goose (*Cereopsis Novæ-Hollandiæ*), which had died in his aviary at Clontarf.

W. J. MAXWELL, C.E.
Some Fossils and Minerals, and a fine Stalactite from Syria.

R. PALMER WILLIAMS, Esq., Dame-street.
Specimens of various Carp, Roach, and Dace.
A Black Swan (*Cygnus atratus*).

J. DOUGLAS OGILBY, Esq., The Nest, Portrush.
A characteristic piece of the skin of a White-sided Dolphin (*Delphinus acutus*), cast ashore at Portrush, this being the first known Irish specimen.

A. WALSH, Esq., M.D., Foxrock.
Some brightly-coloured specimens of *Neritina fluviatilis* from Derryvaragh Lough, co. Westmeath.

J. OLPHERT ADAIR, Esq., 24, Fitzwilliam-square.
An Oyster-catcher, *Hæmatopus Ostralegus*, shot in Wicklow.

Hon. J. P. VEREKER, Merrion-square, South.
A specimen of the common Pea-crab (*Pinnotheres pisum*).

C. PALMER, Esq., Ashbrook, Raheny.
The jaws of a Shark, and the lower jaw of a Fishing Frog (*Lophius piscatorius*). Also a coffin-lid, ornamented with models of arms and armour.

C. WESTON LEES, Esq., 9, Harrington-terrace, South Circular-road.
Specimens of Snakes and Minerals from Australia.

Major P. D. Vigors, Burgage, Leighlin-bridge, Carlow.
Spears from Swan River, Australia.
Arrows from various Islands in the South Pacific.

W. H. Goode, M.D., R.N., Finglas House.
A collection of Arms and Implements and a few Birds from the Fiji Islands.

Right Hon. Lord Talbot de Malahide.
A stuffed specimen of the Argus Frog (*Rana ocellata*) from North America.

Rev. George Harrison Reade, M.A., J.P., Graythorn, Glenageary, Kingstown.
Specimens of a new variety of Quartz and of native Copper from co. Waterford.

Henry C. Harford, Esq., 77th Regt., Curragh of Kildare.
Two Moths from Natal (*Bunæa Angasana* and *Gynanisa Maia*).

G. H. Kinahan, Esq., Geological Survey, Wexford.
An immature specimen of the long-tailed Skua Gull (*Lestris parasiticus*), shot on the coast of Wexford.

Dr. E. Moss, H.M.S. "Alert."
Various Fossils and other specimens collected in the Arctic Expedition.

H. A. Blake, Esq., R.M., Ashfield, Monasterevan.
A spear used in capturing the Sun-fish; from Belmullet.

John Walsh, Esq.
A fawn-coloured Hare, from Gormanstown.

Royal Society, through Trustees of British Museum.
Some bones of *Testudo rodericensis*. A few Birds' Eggs from Kerguelen, and a few Insects from Rodriguez, collected by the Transit of Venus Expedition.

Phineas Riall, J.P., Old Connaught.
An abnormally coloured Mouse, from Clonmel.

Admiral Sir F. L. M'Clintock, Portsmouth.
The stuffed skin of a Globe Fish.

Captain Boxer, R.N., Netley House, Booterstown.
Two jaws of a Skate.

W. Andrews, Esq., Monkstown.
An Osprey (*Pandion Haliæetus*), shot in Kerry, and two Lemon Soles (*Solea aurantiaca*).

Alexander Carte, M.D., F.L.S., *Director*.

1*st March*, 1877.

BOTANIC GARDEN.

The Messrs. VEITCH, Royal Exotic Nursery, King's-road, Chelsea.
Fourteen kinds of rare and valuable plants.

D. W. J. HENRY LE FANU, Esq., Madras Civil Service, through Dr. Moore, 46, Fitzwilliam-square.
Twenty-four kinds of seeds from Madras, and one large root.

C. W. TOWNSHEND, Esq., M. R. Dublin Society.
Seeds of Stone Pine.

WILLIAM PAMPLIN, Esq., Llanderfel, Curneen, North Wales.
Thirty-six kinds of rare bulbs and other plants.

Professor KING, Queen's College, Galway.
Box of mixed seeds from Ceylon.

The Rev. T. ELLACOMBE, Clyst, St. George's, Exeter.
Six kinds of rare plants.

GEORGE MAW, Esq., Benthall Hall, near Broseley, Shropshire.
Thirty-six kinds of very rare hardy plants.

Sir FRANCIS BRADY, Bart., Sorrento Cottage, Dalkey.
Three kinds of seeds of rare plants.

Miss FARMAR, late of Enniscorthy, now of Rome.
Box of mixed plants and seeds from Italy.

Captain HENDERSON, 107th Regiment, Secunderabad, Decare, India.
Case filled with Ferns.

Professor S. O. LINDBERG, University, Helsingfers, Russia.
"Hepaticæ Scandinavicæ, exsiccata guarum specimina, Fasciculus 1, Nemeri 25." For Garden Library.

Mrs. GRAY, British Museum.
"Volume of dried British Algæ," arranged after Harvey, for Botanic Garden Library.

Dr. CASPARY, Director, Botanic Garden, Konigsberg.
Twenty-three packets of seeds.

Dr. DICKIE, Professor of Botany, University, Aberdeen.
Eight kinds of seeds.

Dr. NUTTAL, San Francisco, California, U. S.
Six rare bulbous plants.

Dr. COPELAND, Assistant at Observatory, Dunsink.
Nine kinds of seeds of rare plants.

Dr. DICKIE, University, Aberdeen.
Ten kinds of seeds.

Mr. JOHN WHITE, Hazelwood, Sligo.
Thirty-five rare Irish plants.

The Rev. H. Ellacombe, Bitton Rectory, near Bristol.
Three rare plants.

James Macnab, Esq., Botanic Garden, Edinburgh.
Eight rare plants.

J. Elwes, Esq., Miserdine, Cirencester.
Six seedlings of rare plants.

Herr Ortgies, Inspector, Botanic Garden, Zurich.
Twenty-five valuable plants.

Mr. Johnston, Curator, Botanic Garden, Belfast.
Twenty-four seedling ferns.

A. G. More, Esq., Botanic View, Glasnevin, and Royal Dublin Society.
Two large boxfuls of Alpine plants from Switzerland. (Valuable).

Herr Mayer, Inspector, Botanic Garden, Carlsruhe, Germany.
Fifteen rare plants.

N. J. Berlin, Esq., Oakley-crescent, City-road, London.
Whip made from lace bark-tree, for Botanical Museum.

Mr. Brennan, Steward, &c., to Lord Bantry, Bantry House, co. Cork.
Four very rare Irish plants.

Lieutenant Watson, Royal Engineers, 25, Fitzwilliam-place, Dublin.
Eleven kinds of seeds from Abyssinia.

Captain Jones, Ringwood House, Pembroke-road, Bristol.
Collection of the rarest varieties of British Ferns, twenty-four in number.

Professor Dickie, University, Aberdeen.
Ten packets of rare Indian fern spores.

Rev. Harpur Crewe, The Rectory, Drayton, Beauchamp, Tring.
Crocus roots from Damascus.

The Rev. Mr. Nelson, Aldborough Rectory, Norwich.
Box of fine Anemone roots.

Mr. Backhouse, The Nurseries, York.
Seven rare plants.

The Rev. H. Ellacombe, Rectory, Bitton, near Bristol.
Fifty-eight species of rare plants.

John Ewing, Esq., Curator, Botanic Garden, Sheffield.
Six kinds of valuable plants.

—— Atkins, Esq., Painswick, Gloucestershire.
Twenty species of rare plants.

James MacNab, Esq., Curator, Botanic Garden, Edinburgh.
Forty-five species of rare plants.

J. Latham, Esq., Curator, Botanic Garden, Birmingham.
Twelve kinds of rare plants.

Mr. PARKER, Exotic Nursery, Tooting, Surrey.
Seven rare aquatic plants.

MAX LEICHTLIN, Baden-Baden, Germany.
Four rare herbaceous plants.

Mr. BRIDGFORD, Spafield Nursery, Ball's-bridge.
Nine rare and new plants.

PHINEAS RIALL, Esq., M.R.D.S., Old Connaught, Bray.
Six rare plants.

Mrs. GREGORY, Cool Park, Gort, co. Clare.
Twenty-five kinds of seeds from Ceylon.

DAYCLORE JACKSON, Esq., 30, Stockwell-road, London.
Copy of Gerard's Catalogue of Plants cultivated in Sixteenth Century.

Mons. WITTE, Inspector, Jardin Botanique, Leide, Holland.
Seeds of thirteen kinds of rare Palms.

Messrs. VEITCH, Nurserymen, Royal Exotic Nursery, King's-road, Chelsea.
Fourteen kinds of rare and new plants.

Miss OWEN, Gorey.
Seven species of herbaceous plants.

Mr. BRIDGFORD, Nurseryman, Spafield, Ball's-bridge.
Sixteen kinds of rare plants.

Mrs. MACARTNEY, Clogher.
Parcel of mixed bulbs.

Dr. HOOKER, Royal Gardens, Kew.
Twenty-four herbaceous and Alpine plants.

GEORGE MAW, Esq., Benthal Hall, Broseley, Shropshire.
Bulbs of a new Fritallaria.

P. NEILL FRASER, Esq., Cannon Mills, Edinburgh.
Six kinds of plants.

Dr. GORDON, Hume-street, Dublin.
Ten kinds of seeds from India.

JOHN HOPE, Esq., Wotta-Wotta, Clare, Queensland, Australia.
Fifteen kinds of seeds.

MAX LEICHTLIN, Baden-Baden, Germany.
Ten kinds of rare herbaceous plants.

The Messrs. M'LELAND, Nurserymen, Newry.
One rare plant.

The Rev. HARPUR CREWE, Drayton, Beauchamp, Tring.
Parcel of bulbs.

J. M'NAB, Esq., Curator, Botanic Garden, Edinburgh.
Forty-two kinds of rare plants.

Mr. Gorey, Trinity, Edinburgh.
Twelve kinds of rare plants.

J. H. Kinahan, Esq., Geological Survey, Wexford.
Parcel of rare Irish plants.

John Walsh, Esq., 14, Pembroke-street, Dublin.
Seventeen packets of seeds from India.

Thomas Ware, Nurseryman, Tottenham, near London.
Sixteen kinds of rare plants.

J. F. Curey, Esq., Lismore Castle, Lismore, co. Waterford.
Parcel of roots of Tropæolum speciosum.

Peter Robertson, Nurseryman, Trinity, Edinburgh.
Sixty-two kinds of rare trees and shrubs.

Dr. Paterson, Bridge of Allan.
Two rare plants.

John Russell, Esq., Falkirk.
One rare tree fern.

P. Neill Fraser, Esq., Cannon Mills, Edinburgh.
Eight rare plants.

The Rev. J. Nelson, Aldborough Rectory, Norwich.
Twenty species of herbaceous plants.

W. Potts, Esq., Fettesmount, Lasswade, near Edinburgh.
Fifteen species of Alpine plants.

The Rev. Harpur Crewe, Drayton, Beauchamp, Tring.
Four bulbs.

W. Gumbleton, Esq., Belgrove, Queenstown.
Three bulbs.

Professor De Caisne, Museum d'Histoire Naturelle, Paris.
Packet of very rare seeds.

The Right Hon. Lady Crewe, Calke Abbey, Derby.
Clump of rare hardy Amaryllis.

Walter M. Burke, Esq., Bengal Club, Chirungee, Calcutta (through Mrs. Coghlan, Clonbay, Claremorris.)
Large assortment of mixed seeds from India.

George Maw, Esq., Benthall Hall, Broseley, Shropshire.
Six bulbs of a species of Lilium.

James M'Nab, Esq., Royal Botanic Garden, Edinburgh.
One plant of a rare heath.

George Maw, Esq., Benthall Hall, Broseley, Shropshire.
Six kinds of rare Crocus bulbs.

George Wilson, Esq., Heatherbank, Weybridge Heath.
Six bulbs of the rare Lilium Krameri.

Mr. Speed, the Gardens, Chatsworth, Chesterfield, Derbyshire.
Roots of Nelumbium.

WM. DUNLOP, 52, Morehampton-road, Dublin.
Seeds of a plant from Italy.

Dr. HOOKER, Royal Gardens, Kew.
One hundred and six packages of seeds.

Professor MARTINS, Botanic Gardens, Montpellèer, France.
Ninety-six packages of seeds.

Signior SUSAN, Inspector, Botanic Gardens, Modena.
Fifty packages of seeds.

HERR ORTGIES, Inspector, Botanic Garden, Zurich, Switzerland.
Forty-three packages of seeds.

Signior TODARO, Director, Botanic Garden, Palermo.
Two hundred and forty packages of seeds.

Dr. JAMESON, Superintendent, Botanic Garden, Saharumpore.
Sixty packages of seeds.

HERR BOUCHÉ, Inspector, Botanic Garden, Berlin.
Fifty packages of seeds.

Dr. HOOKER, Royal Gardens, Kew.
Plant of Victoria regia.

Captain THOMPSON, Piperstown, Drogheda.
Four hundred and six packets of seeds (India).

WALTER M. BOURKE, Esq., Bengal Club, Chirungee, Calcutta.
One hundred and four plants of Orchids.

Dr. JAMESON, Superintendent, Botanic Garden, Saharumpore (India).
Ten packets of seeds.

N. E. ELWES, Esq., Miserdine House, near Stroud, Gloucestershire.
Nine rare bulbs from India.

GEORGE MAW, Esq., Benthall Hall, near Broseley, Shropshire.
Six rare bulbs.

J. G. Robertson, Esq., Kilkenny.
Donation for Museum consisting of a graft of evergreen Oak, on a stock of a deciduous species, showing the distinct growths of each.

Dr. HOOKER, Royal Gardens, Kew.
One hundred and three species of rare plants.

WM. SPAIGHT, Derry Castle, Killaloe, county Limerick.
One large and rare plant.

The Rev. HARPUR CREWE, Drayton Beauchamp Rectory, Tring.
Bulbs of a rare species of Crocus.

Mr. WILLIAM BULL, Nurseryman, Kings-road, Chelsea.
A valuable selection of rare Californian bulbs.

The DIRECTOR, Botanic Garden, Saharumpore, India.
Two large parcels of seeds of Palms.

The Right Honorable Lord TALBOT, Malahide Castle.
Three separate parcels of seeds collected in Palestine.

Miss OWENS, Knockmullen, Gorey.
Two plants.

From DIRECTOR, Botanic Garden, Saharumpore.
Ten packets.

From Mr. MOORE, Curator, University Botanic Garden, Balls-bridge.
Four warm house plants.

From the DIRECTOR, Botanic Garden, Saharumpore, India.
One hundred and thirty-five packets of Indian seeds.

The Rev. HARPUR CREWE, Drayton Beauchamp Rectory, Tring.
Six bulbs of Crocus species.

From DIRECTOR, Royal Gardens, Kew.
Thirty packets mixed seeds from the Himalays.

Mrs. BROOKE, Lough Eske, Donegal.
Three packets of African seeds.

From DIRECTOR, Royal Gardens, Kew.
One hundred and seventy packets of seeds.

From R. P. WILLIAMS, Esq., M.R.D.S., Clontarf.
Three kinds of shrubs.

Mr. MOORE, Curator, University Botanic Garden, Balls-bridge.
Twelve kinds of plants.

From JAMES NIVEN, Esq., Botanic Garden, Hull.
Fifty-six packets of seeds.

From Mr. M'NAB, Royal Botanic Garden, Edinburgh.
One packet of seeds of Lilium Polyphyllum.

From ROYAL GARDENS, Kew.
Packet of seeds of Shiraz Tobacco.

Dr. HOOKER, Royal Gardens, Kew.
Eighty packets of seeds

Mrs. DEAN, Leinster-road.
Twelve kinds of Indian seeds.

WILLIAM HUGGINS, London.
One rare plant.

The Rev. H. T. ELLACOMBE Clyst St. Mary's, Topsham, Exeter.
One plant.

Mrs. LAWRENSON, Nurney House, Kildare.
Package of fine Anemone seed.

Dr. TODARO, Director, Botanic Garden, Palermo.
Two hundred and sixteen packets of seeds.

Herr ORTGIES, Inspector, Botanic Garden, Zurich.
Thirty-four packets of seeds.

Professor De Caisne, Museum d'Histoire Naturelle, Paris.
Ninety packets of seeds.

T. Moore, Esq., Curator, Botanic Garden, Chelsea.
Twenty-two packets of seeds.

Dr. Reichenbach, Director, Botanic Garden, Hamburg.
Thirty-nine packets of seeds.

Dr. Schomburgk, Director, Botanic Garden, Adelaide, Australia.
Eighty-five packets of seeds.

Miss Farmar, 44, Via Condotti, Rome.
Seven packets of mixed seeds.

Dr. Calmiero, Director, Botanic Garden, Madrid.
Eighty-nine packets of seeds.

Herr Bouché, Inspector, Botanic Gardens, Berlin.
Fifty-four packets of seeds.

Dr. Dickie, Professor of Botany, University, Aberdeen.
Nine packets of seeds.

William Sinclair, Esq., Holyhill, Strabane.
One packet of seeds.

Dr. Hooker, Kew.
Plant of Victoria Regia.

The Rev. H. T. Ellacombe, Clyst St. Mary's, Topsham, Exeter.
Five plants.

E. O. MacDevitt, Shelbourne Hotel, Dublin.
Wardian case of plants from Australia.

Henry Roe, Esq., Mount Annville
Fine plant of a rare Cycas.

George Maw, Esq., Benthall Hall, Broseley, Shropshire.
Six rare plants.

The Rev. H. Ellacombe, Bitton Rectory, near Bristol.
Three rare plants.

David Moore, *Director*.

12*th May*, 1877.

APPENDIX.

METEOROLOGICAL JOURNAL,

KEPT AT

The Royal Dublin Society's Botanic Garden, Glasnevin,

FROM

1st JANUARY to 31st DECEMBER, 1875.

JANUARY, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Friday,	29·528	41	29·583	39·9	38·2	40·0	34·2	33·0	34·2	72·4	28·9	S.E.	·060	Stormy, wet, changeable.
2 Saturday,	29·722	49	29·753	48·1	44·4	59·1	37·9	36·1	37·0	78·0	31·2	S.W.	·040	Fine, breezy, bright sun.
3 Sunday,	29·864	50	29·890	48·9	44·9	50·9	42·0	37·6	37·9	82·0	35·6	S.W.	·000	Do.
4 Monday,	29·470	51	29·497	49·8	48·2	51·0	43·2	39·4	50·0	80·2	37·0	S.E.	·080	Cloudy, showery, changeable.
5 Tuesday,	29·754	51	29·770	50·4	47·8	51·6	41·0	40·0	41·0	67·0	34·1	S.W.	·060	Breezy, cloudy, light showers.
6 Wednesday,	29·630	56	29·639	54·9	51·9	55·2	48·9	42·0	42·4	73·6	42·8	S.W.	·000	Breezy, occasional sun.
7 Thursday,	29·9[illegible]0	53	29·971	52·0	47·9	53·0	41·2	42·0	43·0	88·4	34·6	S.W.	·000	Fine, mild, bright sun.
8 Friday,	29·892	47	29·929	45·8	43·9	46·4	30·8	39·2	41·2	90·4	24·4	S.W.	·060	Breezy, cloudy, occasional sun.
9 Saturday,	29·628	48	29·659	46·0	44·2	48·0	45·0	41·1	42·1	73·6	41·1	S.E.	·000	Cloudy, light showers.
10 Sunday,	29·628	48	29·659	47·2	45·9	47·9	45·2	41·0	42·6	59·4	37·1	S.E.	·030	Do.
11 Monday,	29·780	47	29·811	46·4	43·0	47·4	31·2	39·0	41·4	68·2	26·9	S.E.	·050	Breezy, cloudy, changeable.
12 Tuesday,	29·750	51	29·776	49·9	47·2	50·0	46·2	41·0	42·6	68·6	41·4	S.W.	·000	Fine, breezy, bright sun.
13 Wednesday,	29·746	51	29·772	50·8	49·0	51·0	44·8	42·0	43·0	80·0	35·6	S.E.	·070	Breezy, cloudy, light showers.
14 Thursday,	29·858	57	29·867	56·0	51·8	56·4	46·2	43·4	44·2	84·0	33·8	S.W.	·040	Fine, breezy, bright sun.
15 Friday,	29·400	55	29·416	54·6	50·0	55·2	47·2	44·0	45·4	89·0	37·4	S.W.	·020	Breezy, light showers, occasional sun.
16 Saturday,	29·472	51	29·519	50·0	46·8	51·2	45·0	43·5	44·8	82·0	37·8	S.W.	·000	Fine, breezy, bright sun.
17 Sunday,	29·524	47	29·561	46·2	44·0	46·9	45·3	42·0	43·8	70·0	39·8	S.W.	·280	Cloudy, wet, changeable.
18 Monday,	29·544	53	29·565	51·8	49·8	52·0	45·1	44·2	45·4	67·4	43·2	S.W.	·020	Breezy, showery, occasional sun.
19 Tuesday,	29·950	56	29·959	54·6	51·4	55·0	45·2	45·0	45·9	72·8	43·0	S.W.	·430	Stormy, light showers, occasional sun.
20 Wednesday,	29·372	49	29·399	47·2	43·9	48·2	43·6	43·2	45·1	69·4	37·2	S.W.	·030	Do. [lightning.
21 Thursday,	29·344	40	29·379	38·9	37·2	39·6	37·1	40·0	42·4	76·2	31·4	N.E.	·000	Cloudy, light showers, thunder and
22 Friday,	29·950	40	30·050	38·9	36·6	39·4	28·9	36·2	39·8	76·4	23·8	S.W.	·090	Breezy, bright sun, sharp frost.
23 Saturday,	29·490	50	29·517	47·9	44·8	48·4	35·4	39·3	40·4	80·1	29·6	S.W.	·080	Cloudy, light showers, changeable.
24 Sunday,	28·704	48	28·737	47·2	43·4	49·0	37·1	39·4	41·2	69·4	31·9	S.W.	·040	Breezy, cloudy, occasional sun.
25 Monday,	29·380	46	·29·427	45·2	43·8	46·0	36·2	38·2	40·2	72·0	31·9	S.W.	·000	Do.
26 Tuesday,	29·956	45	29·998	43·8	42·6	44·0	34·0	37·4	39·8	70·4	29·4	S.E.	·040	Breezy, showery, changeable.
27 Wednesday,	29·880	55	29·895	53·8	50·1	54·0	43·4	41·2	43·4	64·6	37·2	S.E.	·020	Cloudy, mild, changeable.
28 Thursday,	30·036	51	30·061	50·0	47·6	50·4	46·0	42·0	43·0	74·2	38·9	S.W.	·180	Breezy, showery, bright sun.
29 Friday,	30·152	48	30·183	46·6	45·4	47·2	41·0	41·2	42·6	87·0	35·0	S.E.	·170	Cloudy, showery, changeable.
30 Saturday,	30·494	52	30·516	50·0	47·8	50·6	48·0	42·6	44·0	72·4	38·4	S.E.	·000	Fine, mild, bright sun.
31 Sunday,	30·374	54	30·391	53·0	50·2	55·0	45·4	43·0	44·2	87·4	39·9	S.E.	·000	Do.
													1·890	

FEBRUARY, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Monday, .	30·220	51	30·245	50·6	48·4	51·0	46·9	43·4	44·6	73·4	38·9	S.W.	·030	Breezy, cloudy, occasional sun.
2 Tuesday, .	30·172	49	30·197	47·9	46·4	48·2	43·0	43·0	44·8	71·2	38·4	S.E.	·040	Cloudy, showery, changeable.
3 Wednesday, .	30·000	46	30·036	45·6	42·4	46·4	42·0	42·0	44·0	75·0	37·8	N.W.	·000	Cloudy, showery, occasional sun.
4 Thursday, .	30·082	47	30·118	45·9	40·6	46·0	27·6	39·2	42·0	94·6	22·4	S.E.	·000	Fine, bright sun, sharp frost.
5 Friday, .	30·256	42	30·305	41·2	39·9	41·7	30·0	36·9	39·2	88·0	22·4	S.E.	·150	Cloudy, rain-like.
6 Saturday, .	30·040	48	30·071	46·9	46·4	47·2	40·1	39·0	40·5	67·6	36·1	N.E.	·020	Cloudy, showery, changeable.
7 Sunday, .	30·022	46	30·058	45·0	43·8	45·8	41·4	40·0	41·4	59·4	39·2	N.W.	·020	Cloudy, light showers.
8 Monday, .	30·210	49	30·241	48·2	45·4	48·6	34·6	40·2	42·4	89·0	29·9	E.	·000	Fine, mild, bright sun.
9 Tuesday, .	29·940	42	29·989	40·8	38·6	41·2	35·6	38·2	40·3	82·0	28·2	S.E.	·000	Breezy, cloudy, changeable.
10 Wednesday, .	30·094	45	30·136	44·0	40·6	44·3	37·9	38·2	40·6	63·4	34·8	S.E.	·000	Cloudy, occasional sun.
11 Thursday, .	29·840	46	29·877	45·4	43·6	45·9	38·0	38·2	40·6	78·0	31·2	S.E.	·040	Breezy, cloudy, light showers.
12 Friday, .	29·806	48	29·837	47·2	46·4	48·4	40·2	40·0	41·4	59·4	36·6	S.E.	·020	Cloudy, mild, light showers.
13 Saturday, .	29·900	54	29·916	51·9	49·6	52·4	47·0	43·4	44·0	71·4	43·9	S.W.	·060	Breezy, cloudy, occasional sun.
14 Sunday, .	29·950	52	29·971	51·6	48·0	52·4	45·9	43·4	45·0	96·0	41·2	S.W.	·000	Fine, breezy, bright sun.
15 Monday, .	30·354	52	30·374	51·2	46·6	51·8	35·6	41·8	44·0	99·4	30·6	S.W.	·000	Do.
16 Tuesday, .	30·570	48	30·600	46·8	43·0	47·0	33·9	40·4	42·2	104·0	29·2	N.W.	·000	Breezy, cloudy, occasional sun.
17 Wednesday, .	30·462	48	30·493	47·2	44·0	47·9	35·4	40·6	42·6	91·0	29·6	N.E.	·000	Fine, breezy, bright sun.
18 Thursday, .	30·332	45	30·373	43·9	39·8	44·2	29·2	37·8	41·2	93·2	25·3	S.E.	·020	Fine, bright sun, sharp frost.
19 Friday, .	30·260	42	30·309	40·8	36·9	41·4	33·4	37·4	39·8	87·0	29·6	S.E.	·170	Breezy, cloudy, snow showers, occasional sun.
20 Saturday, .	30·156	39	30·215	36·1	34·8	38·2	34·0	36·1	38·6	95·8	31·0	S.E.	·820	Breezy, cold, snow showers.
21 Sunday, .	30·270	42	30·319	41·0	37·8	44·6	34·0	36·6	38·2	68·2	31·0	S.E.	·000	Stormy, cold, occasional sun.
22 Monday, .	30·236	44	30·279	42·4	39·1	44·8	33·2	37·1	39·0	93·5	29·1	S.E.	·000	Fine, breezy, bright sun.
23 Tuesday, .	29·900	42	29·949	39·1	35·0	39·4	32·4	36·9	38·4	93·3	27·0	S.E.	·110	Do.
24 Wednesday, .	29·456	36	29·512	34·6	32·1	35·0	29·1	34·2	36·9	62·4	26·8	N.E.	·510	Breezy, cold, snow showers.
25 Thursday, .	29·450	39	29·500	36·8	35·0	37·4	33·8	34·0	36·4	70·2	30·0	N.W.	·390	Do.
26 Friday, .	29·400	41	29·455	39·2	38·4	40·6	36·2	35·0	37·0	64·6	33·0	S.E.	·340	Breezy, showery, cold, changeable.
27 Saturday, .	29·696	41	29·751	37·9	36·1	38·4	34·9	35·6	37·2	44·6	32·8	S.E.	·040	Cloudy, showery, changeable.
28 Sunday, .	29·872	41	29·927	35·4	33·9	38·0	35·0	34·6	36·8	49·6	31·2	N.E.	·050	Cloudy, cold, changeable.
													2·830	

MARCH, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Monday, .	29·908	41	29·963	37·6	35·8	39·2	33·3	34·2	36·4	59·6	31·4	N.E.	·020	Breezy, cold, snow showers.
2 Tuesday, .	29·988	41	30·043	38·9	35·8	40·0	35·4	34·8	36·6	71·2	31·6	N.E.	·040	Breezy, cold, occasional sun.
3 Wednesday, .	29·910	42	29·959	37·8	35·6	39·0	34·9	34·6	36·2	60·0	31·6	N.E.	·000	Breezy, cold, changeable.
4 Thursday, .	29·924	42	29·973	37·8	35·2	39·2	35·9	34·2	36·2	51·4	31·8	N.E.	·000	Do.
5 Friday, .	29·760	43	29·809	40·6	38·2	42·0	37·0	35·2	37·0	63·2	34·9	S.E.	·400	Do.
6 Saturday, .	29·404	48	29·436	47·2	46·1	47·0	40·0	37·6	38·4	66·6	36·0	S.E.	·020	Cloudy, wet, changeable.
7 Sunday, .	29·632	58	29·636	55·2	51·6	56·4	45·6	40·8	41·4	95·9	36·8	S.W.	·020	Breezy, light showers, occasional sun.
8 Monday, .	29·900	58	29·904	52·1	49·4	53·6	44·9	41·6	42·4	89·4	37·6	S.E.	·000	Cloudy, mild, occasional sun.
9 Tuesday, .	30·112	52	30·133	48·9	43·4	49·4	43·4	41·4	43·0	101·6	37·2	S.W.	·000	Stormy, cloudy, occasional sun.
10 Wednesday, .	30·340	51	30·365	48·9	44·6	50·0	29·4	40·0	42·4	106·4	25·6	S.E.	·000	Breezy, bright sun.
11 Thursday, .	30·162	49	30·194	47·8	40·2	48·0	39·2	40·0	42·1	111·0	33·0	S.E.	·000	Do.
12 Friday, .	30·000	40	30·054	38·6	35·9	39·2	36·9	38·0	40·0	98·4	31·2	N.E.	·020	Breezy, cold, light hail showers.
13 Saturday, .	29·990	41	30·045	39·8	36·9	40·0	36·9	37·9	40·0	47·3	33·3	N.E.	·000	Do.
14 Sunday, .	30·090	45	30·131	43·8	42·0	44·2	37·2	37·4	39·2	56·4	34·9	N.E.	·020	Breezy, cold, changeable.
15 Monday, .	30·182	47	30·218	45·4	42·9	45·9	39·4	38·6	40·0	59·6	37·0	S.E.	·000	Cloudy, mild, light showers.
16 Tuesday, .	30·186	48	30·217	46·4	45·1	47·4	34·8	39·0	40·8	77·0	32·0	N.E.	·060	Cloudy, mild, changeable.
17 Wednesday, .	30·504	43	30·552	41·2	39·0	42·1	33·9	38·2	41·4	69·0	28·4	N.E.	·000	Breezy, showery, occasional sun.
18 Thursday, .	30·578	48	30·608	45·9	40·6	47·6	34·0	38·6	40·8	74·6	29·2	N.W.	·000	Fine, breezy, bright sun.
19 Friday, .	30·244	51	30·269	50·2	49·0	51·0	41·9	40·1	41·4	99·0	36·0	S.W.	·110	Cloudy, light showers, changeable.
20 Saturday, .	30·204	49	30·235	46·4	42·1	47·9	31·9	40·2	42·0	107·4	27·6	N.E.	·000	Fine, breezy, bright sun.
21 Sunday, .	30·172	47	30·208	45·2	44·0	46·0	31·8	38·6	40·1	118·0	26·8	S.W.	·070	Cloudy, light showers.
22 Monday, .	30·204	50	30·229	49·9	47·0	50·4	42·5	40·6	42·2	75·0	39·5	S.W.	·000	Cloudy, showery, occasional sun.
23 Tuesday, .	30·346	55	30·360	54·9	47·9	54·9	40·9	42·0	43·6	100·0	32·4	S.W.	·000	Cloudy, mild, occasional sun.
24 Wednesday, .	30·320	56	30·348	54·1	48·0	55·6	43·8	42·4	44·0	108·9	39·0	S.W.	·000	Do.
25 Thursday, .	30·142	52	30·162	50·8	47·9	51·4	45·6	43·0	44·4	105·0	39·2	S.W.	·090	Breezy, cloudy, changeable.
26 Friday, .	30·070	53	30·090	51·0	48·0	52·3	46·4	43·8	45·2	100·0	42·2	S.W.	·020	Breezy, showery, occasional sun.
27 Saturday, .	30·078	52	30·098	49·2	44·0	50·6	40·2	42·4	44·3	111·4	35·4	S.W.	·000	Breezy, light showers, bright sun.
28 Sunday, .	30·420	54	30·435	52·2	45·8	53·1	39·2	41·4	43·6	110·0	34·0	N.W.	·000	Fine, breezy, bright sun, changeable.
29 Monday, .	30·530	53	30·549	52·4	46·8	53·4	43·2	42·0	44·1	111·4	38·9	N.W.	·000	Do.
30 Tuesday, .	30·594	54	30·607	52·8	48·0	53·7	43·8	43·0	44·4	110·6	37·8	N.W.	·000	Breezy, cloudy, changeable.
31 Wednesday, .	30·640	54	30·653	52·1	46·2	53·4	45·0	43·2	44·9	76·4	42·5	S.W.	·000	Cloudy, mild, changeable.
													·890	

APRIL, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Thursday,	30·630	54	30·643	51·4	44·9	52·0	41·9	43·4	45·0	85·6	38·2	S.W.	·000	Cloudy, mild, occasional sun.
2 Friday,	30·100	53	30·420	50·6	44·6	51·2	42·2	43·0	45·4	79·4	38·0	S.W.	·000	Breezy, cloudy, changeable.
3 Saturday,	29·674	55	29·690	53·1	50·0	54·0	45·4	44·6	45·2	85·4	42·0	S.W.	·000	Do.
4 Sunday,	29·608	53	29·629	51·4	44·6	52·4	37·9	42·8	44·6	94·0	32·9	S.W.	·020	Breezy, cloudy, occasional sun.
5 Monday,	29·008	48	29·040	46·1	42·2	47·0	39·6	42·2	44·2	107·0	36·9	S.W.	·000	Cloudy, light showers, occasional sun.
6 Tuesday,	29·252	54	29·269	52·0	45·4	53·6	38·2	41·2	43·4	118·0	31·9	N.W.	·020	Breezy, occasional sun.
7 Wednesday,	29·350	46	29·388	44·8	41·7	45·2	33·8	40·2	42·4	88·6	29·6	N.W.	·000	Cloudy, showery, occasional sun.
8 Thursday,	29·958	52	29·979	51·6	46·6	52·0	35·0	41·0	43·0	99·0	31·2	S.E.	·000	Breezy, cloudy, occasional sun.
9 Friday,	30·200	53	30·220	51·2	45·8	52·4	43·4	42·6	44·0	106·0	38·0	N.E.	·000	Do.
10 Saturday,	30·314	48	30·345	45·8	43·9	46·2	42·8	42·8	44·3	118·6	39·6	N.E.	·000	Breezy, cloudy, changeable.
11 Sunday,	30·278	49	30·309	48·2	45·0	48·6	40·4	42·0	44·0	76·0	32·8	N.E.	·000	Do.
12 Monday,	30·282	48	30·313	46·9	44·0	47·4	43·9	43·0	44·8	109·0	41·2	N.E.	·000	Breezy, cloudy, occasional sun.
13 Tuesday,	30·324	54	30·337	52·8	46·2	53·6	31·9	42·8	44·9	112·4	27·6	N.E.	·000	Fine, breezy, bright sun.
14 Wednesday,	30·332	56	30·340	55·4	49·0	56·0	31·2	42·4	45·0	119·0	28·0	S.E.	·000	Do.
15 Thursday,	30·374	58	30·377	56·9	50·2	57·0	30·0	42·8	44·9	119·4	26·8	S.E.	·000	Do.
16 Friday,	30·270	60	30·279	59·1	53·2	59·4	37·0	44·0	45·8	108·8	30·9	S.E.	·000	Do.
17 Saturday,	30·118	60	30·150	58·9	52·4	59·2	33·2	45·2	46·8	111·4	28·6	S.E.	·000	Do.
18 Sunday,	30·060	62	30·052	59·4	52·0	60·6	33·9	45·0	46·0	120·0	28·9	S.E.	·000	Do.
19 Monday,	30·116	63	30·108	61·4	53·8	61·6	34·2	45·4	47·2	118·0	29·6	N.E.	·000	Do.
20 Tuesday,	30·072	64	30·059	62·9	54·6	63·4	38·6	45·8	48·0	122·4	30·4	S.E.	·000	Do.
21 Wednesday,	29·888	61	29·887	57·6	50·9	58·6	42·0	47·0	48·6	119·0	34·9	S.E.	·290	Cloudy, mild, changeable.
22 Thursday,	29·896	47	29·933	45·6	41·9	46·0	46·4	45·0	47·2	76·2	41·4	S.E.	·000	Breezy, showery, changeable.
23 Friday,	30·012	52	30·032	51·0	45·8	53·0	31·0	43·8	46·0	102·0	27·0	S.E.	·000	Fine, breezy, bright sun, sharp frost.
24 Saturday,	30·210	57	30·218	55·2	48·2	55·8	31·0	43·8	45·9	110·8	26·0	S.E.	·000	Do.
25 Sunday,	30·254	53	30·274	51·8	47·9	52·4	41·9	46·0	46·2	95·4	32·2	S.E.	·000	Breezy, cloudy, occasional sun.
26 Monday,	29·972	49	29·998	47·0	46·2	48·6	43·4	44·0	45·8	78·0	35·6	S.E.	·380	Cloudy, wet, changeable.
27 Tuesday,	30·026	61	30·023	59·4	53·2	61·0	47·0	46·4	47·2	102·0	42·4	S.W.	·000	Breezy, cloudy, occasional sun.
28 Wednesday,	30·122	63	30·114	61·4	54·2	62·3	43·2	48·0	49·4	115·6	36·0	S.W.	·000	Do.
29 Thursday,	30·120	63	30·112	61·2	55·8	62·2	47·9	49·2	50·4	112·0	40·2	S.E.	·020	Breezy, cloudy, light showers, occasional sun.
30 Friday,	30·020	60	30·017	57·0	53·2	58·0	48·9	49·2	50·4	88·0	44·2	S.E.	·030	Breezy, cloudy, changeable.
													·760	

MAY, 1875.

Date.	Barometer.			Thermometer.								Wind.	Rain.	Remarks.
	Uncorrected.	Attached Thermometer.	Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers.				Earth Thermometers.		Grass Thermometers freely exposed.		Direction.	Previous 24 Hours.	
				Dry B.	Wet B.	Max.	Min.	5 Inch.	10 Inch.	Max.	Min.			
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Saturday, .	29·880	53	29·884	55·9	53·2	56·7	45·2	48·1	50·2	86·4	39·1	N.E.	·080	Cloudy, showery, changeable.
2 Sunday, .	29·882	62	29·876	61·4	55·2	62·0	42·0	49·0	50·6	115·0	38·9	S.E.	·020	Breezy, showery, occasional sun.
3 Monday, .	29·818	60	29·817	58·8	55·2	59·4	50·0	50·0	51·0	112·4	48·0	S.E.	·000	Cloudy, showery, occasional sun.
4 Tuesday, .	30·036	60	30·033	58·1	53·6	59·8	49·0	50·4	51·9	123·0	42·6	S.E.	·000	Cloudy, mild, occasional sun.
5 Wednesday, .	29·950	61	29·949	59·6	54·2	60·0	49·0	51·0	52·4	111·4	46·2	S.E.	·000	Fine, breezy, bright sun.
6 Thursday, .	29·512	58	29·516	56·2	53·0	57·4	48·8	50·4	52·0	121·9	42·6	S.W.	·000	Breezy, cloudy, rain-like.
7 Friday, .	29·500	59	29·504	56·6	51·4	57·8	43·2	50·0	51·4	123·6	34·8	S.E.	·010	Breezy, cloudy, occasional sun.
8 Saturday, .	29·570	68	29·948	66·6	51·4	66·9	48·9	52·5	53·4	124·2	39·8	S.W.	·000	Fine, breezy, bright sun.
9 Sunday, .	29·654	67	29·635	65·6	55·4	66·4	48·8	52·0	53·6	125·0	43·6	S.W.	·000	Do.
10 Monday, .	30·258	60	30·255	58·0	49·9	59·2	41·0	49·8	51·9	104·1	35·0	S.W.	·000	Do.
11 Tuesday, .	30·228	64	30·215	62·6	57·9	63·0	50·2	50·0	52·4	123·4	47·0	S.W.	·000	Breezy, cloudy, changeable.
12 Wednesday, .	30·312	66	30·291	64·1	58·9	65·4	53·2	53·0	54·0	128·0	47·2	S.W.	·000	Fine, breezy, bright sun.
13 Thursday, .	30·344	68	30·318	65·8	59·4	66·8	54·4	55·0	55·6	130·2	48·8	S.W.	·000	Do.
14 Friday, .	30·234	72	30·197	69·8	61·4	70·2	45·2	55·6	56·2	138·8	40·6	S.E.	·100	Fine, bright sun, very sultry.
15 Saturday, .	30·280	66	30·259	62·8	53·2	63·4	54·8	56·0	57·3	132·6	49·9	S.W.	·000	Fine, breezy, bright sun, light showers.
16 Sunday, .	30·340	65	30·325	61·6	52·8	62·6	40·0	54·6	55·9	134·6	32·9	S.E.	·000	Fine, breezy, bright sun.
17 Monday, .	30·000	65	29·985	63·2	55·4	63·4	39·0	54·0	56·0	129·4	32·0	S.E.	·070	Do.
18 Tuesday, .	29·542	57	29·551	54·6	48·2	55·8	47·0	51·6	55·0	131·0	42·6	S.W.	·010	Breezy, showery, occasional sun.
19 Wednesday, .	29·596	60	29·595	57·9	49·0	58·6	39·4	50·4	53·0	132·0	35·8	N.W.	·020	Breezy, hail showers, occasional sun.
20 Thursday, .	29·428	58	29·433	56·6	53·9	57·4	47·0	50·0	52·6	127·0	41·0	N.W.	·170	Breezy, showery, occasional sun.
21 Friday, .	29·312	54	29·323	54·8	52·6	55·6	46·0	51·0	52·6	121·0	39·0	S.E.	·130	Breezy, showery, changeable.
22 Saturday, .	29·570	55	29·585	54·4	48·6	54·8	42·4	49·4	51·8	111·0	39·0	S.W.	·130	Breezy, showery, occasional sun.
23 Sunday, .	30·030	60	30·027	58·4	49·6	59·0	44·0	49·4	51·2	129·4	38·8	S.W.	·000	Do.
24 Monday, .	30·280	70	30·249	69·0	60·0	69·9	47·4	52·0	53·0	138·0	41·9	S.W.	·000	Fine, breezy, bright sun.
25 Tuesday, .	30·394	65	30·379	63·9	54·9	64·2	49·2	53·0	54·4	140·2	42·4	S.W.	·000	Breezy, cloudy, occasional sun.
26 Wednesday, .	30·412	62	30·404	60·8	52·0	61·4	49·0	53·6	54·6	131·4	45·2	S.W.	·000	Do.
27 Thursday, .	30·346	63	30·338	61·4	55·6	62·0	41·2	51·0	53·8	136·2	35·6	S.W.	·190	Do.
28 Friday, .	29·854	57	29·863	55·8	52·0	56·2	52·0	52·0	54·0	119·0	51·2	N.E.	·000	Cloudy, light showers, occasional sun.
29 Saturday, .	30·028	57	30·036	55·0	53·2	55·4	46·0	52·1	54·2	127·3	41·1	N.E.	·000	Breezy, cold, occasional sun.
30 Sunday, .	30·010	55	30·024	53·2	49·0	54·2	39·0	50·0	53·0	130·0	33·4	N.E.	·000	Cloudy, cold, changeable.
31 Monday, .	30·098	62	30·090	61·0	54·2	62·4	51·0	53·0	54·2	108·0	49·8	S.E.	·000	Cloudy, mild, occasional sun.
													·930	

JUNE, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Tuesday,	30·270	66	30·249	65·2	57·4	65·8	38·8	53·4	55·0	130·0	33·2	S.E.	·000	Fine, warm, bright sun.
2 Wednesday,	30·234	64	30·221	62·4	55·2	63·0	44·8	54·8	56·2	134·2	36·2	N.W.	·000	Fine, breezy, bright sun.
3 Thursday,	30·040	67	30·019	66·0	57·8	66·8	50·0	56·0	57·0	142·0	43·2	S.E.	·000	Fine, mild, overcast, bright sun.
4 Friday,	29·994	67	29·973	66·0	56·6	66·4	49·2	57·2	58·6	146·4	41·6	N.W.	·000	Breezy, cloudy, occasional sun.
5 Saturday,	29·960	61	29·959	59·2	53·4	60·0	45·9	55·1	57·3	150·2	34·8	S.W.	·120	Cloudy, showery, occasional sun.
6 Sunday,	29·728	67	29·709	65·8	61·4	66·4	54·4	55·8	57·0	125·0	49·8	S.W.	·220	Breezy, showery, occasional sun.
7 Monday,	29·928	70	29·897	69·9	61·2	70·0	53·0	57·0	58·6	142·6	49·0	S.W.	·000	Do.
8 Tuesday,	30·258	68	30·232	66·2	52·9	67·2	47·6	55·0	57·2	149·8	40·4	S.W.	·030	Fine, mild, bright sunshine.
9 Wednesday,	29·612	66	29·593	63·8	57·4	64·4	52·2	56·0	57·8	149·2	49·0	S.E.	·040	Breezy, light showers, occasional sun.
10 Thursday,	29·518	62	29·512	62·4	55·0	63·2	49·2	54·2	56·6	129·0	44·0	S.E.	·150	Do. [thunderstorm.
11 Friday,	29·522	56	29·531	54·0	50·0	55·4	46·8	51·8	54·2	135·0	41·8	S.W.	·670	Breezy, showery, occasional sun, slight
12 Saturday,	29·526	62	29·520	60·4	53·9	61·6	42·0	51·8	54·2	142·0	36·0	S.W.	·250	Cold, heavy hail showers, thunder and lightning, occasional sun.
13 Sunday,	29·542	59	29·541	57·0	52·9	58·0	46·2	51·0	54·0	132·4	41·2	S.W.	·210	Cloudy, hail showers, slight thunder, occasional sun.
14 Monday,	29·204	61	29·204	60·2	53·8	60·8	52·0	52·4	54·8	124·6	47·6	S.W.	·150	Breezy, showery, occasional sun.
15 Tuesday,	29·090	59	29·095	56·8	51·4	57·6	44·9	51·6	54·2	136·0	37·6	S.W.	·210	Do.
16 Wednesday,	29·430	59	29·408	57·2	54·6	58·4	48·4	51·4	54·0	125·8	44·9	S.W.	·340	Do. [occasional sun.
17 Thursday,	29·906	60	29·905	58·2	54·2	59·4	44·2	51·0	53·6	128·4	38·6	S.W.	·150	Breezy, heavy showers, slight thunder,
18 Friday,	30·118	64	30·105	61·2	53·6	62·6	41·2	51·2	53·8	141·0	35·6	S.W.	·000	Breezy, showery, bright sun.
19 Saturday,	30·000	66	29·979	64·9	61·2	65·4	53·6	53·6	55·4	123·6	46·8	S.W.	·040	Cloudy, light showers, changeable.
20 Sunday,	29·950	66	29·929	64·2	56·0	65·4	45·9	53·6	55·4	128·0	34·8	S.W.	·200	Fine, breezy, cloudy, occasional sun.
21 Monday,	29·874	61	29·873	59·8	55·0	60·4	43·6	52·0	54·6	130·6	36·6	S.W.	·380	Cloudy, showery, occasional sun.
22 Tuesday,	30·068	62	30·060	60·8	56·2	61·0	45·0	52·0	54·4	123·4	39·0	S.W.	·000	Breezy, heavy hail showers, occasional
23 Wednesday,	30·204	63	30·196	61·0	55·9	62·4	54·6	53·9	55·6	129·0	51·8	S.W.	·060	Breezy, cloudy, occasional sun. [sun.
24 Thursday,	30·210	72	30·173	70·6	63·4	71·0	52·0	55·2	57·4	130·4	47·2	S.W.	·000	Cloudy, mild, occasional sun.
25 Friday,	29·968	68	29·942	66·0	59·0	67·2	59·8	57·2	58·6	137·2	56·4	S.W.	·070	Breezy, cloudy, occasional sun.
26 Saturday,	29·942	64	29·930	62·4	58·6	63·8	57·0	54·8	57·2	126·4	43·4	S.W.	·040	Breezy, showery, bright sun.
27 Sunday,	29·780	57	29·789	55·8	52·0	56·2	48·4	53·8	56·0	127·0	43·4	S.E.	·170	Breezy, showery, changeable.
28 Monday,	29·824	63	29·818	61·4	58·2	62·4	53·9	54·2	56·0	89·4	52·6	S.E.	·110	Cloudy, showery, mild, changeable.
29 Tuesday,	29·904	62	29·898	60·8	58·2	61·2	54·6	55·6	57·0	91·6	52·8	S.E.	·000	Cloudy, mild, changeable.
30 Wednesday,	29·860	60	29·859	59·0	56·0	60·0	56·0	57·0	58·6	131·0	54·8	S.E.	·000	Do.
													3·550	

JULY, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Thermometer. Shade Thermometers. Wet B.	Thermometer. Shade Thermometers. Max.	Thermometer. Shade Thermometers. Min.	Thermometer. Earth Thermometers. 5 Inch.	Thermometer. Earth Thermometers. 10 Inch.	Thermometer. Grass Thermometers freely exposed. Max.	Thermometer. Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Thursday, .	29·660	69	29·636	68·0	63·2	68·6	53·9	58·0	59·4	140·4	52·4	S. E.	·020	Cloudy, overcast, occasional sun.
2 Friday, .	29·758	61	29·757	59·9	51·0	60·8	54·6	56·0	58·2	147·2	52·0	S. W.	·070	Breezy, light showers, occasional sun.
3 Saturday, .	30·148	63	30·140	61·4	55·0	62·4	49·0	54·2	56·9	97·6	47·4	S. E.	·000	Breezy, cloudy, changeable.
4 Sunday, .	30·446	69	30·415	67·9	59·8	68·2	49·2	55·4	57·2	129·0	44·8	S. W.	·000	Cloudy, mild, bright sun.
5 Monday, .	30·460	69	30·429	67·1	61·0	68·0	56·2	57·6	59·4	157·4	50·6	S. W.	·000	Cloudy, mild, occasional sun.
6 Tuesday, .	30·430	71	30·399	69·6	60·8	70·4	53·2	59·4	60·6	147·2	48·4	S. W.	·000	Fine, mild, bright sun.
7 Wednesday, .	30·360	73	30·323	71·6	65·0	72·6	57·0	60·4	61·6	147·6	54·0	S. W.	·010	Do.
8 Thursday, .	30·048	71	30·017	70·4	62·0	71·0	54·0	60·2	62·0	156·0	50·1	S. W.	·280	Cloudy, mild, light showers, occasional sun.
9 Friday, .	29·472	62	29·467	59·9	51·0	61·2	53·6	58·4	61·2	120·0	52·6	S. E.	·120	Cloudy, showery, changeable.
10 Saturday, .	29·678	64	29·666	62·4	55·2	63·6	50·4	55·4	57·8	118·0	47·4	S. W.	·220	Breezy, showery, occasional sun.
11 Sunday, .	29·754	58	29·758	58·0	53·9	58·4	48·7	53·8	56·6	120·0	44·6	S. W.	·150	Do.
12 Monday, .	30·151	64	30·141	63·6	54·8	64·2	49·4	53·9	56·8	125·4	46·4	S. W.	·000	Breezy, showery, thunder, occasional sun.
13 Tuesday, .	30·156	64	30·143	61·6	55·8	63·0	49·2	55·2	57·2	132·0	45·8	S. E.	·060	Breezy, cloudy, changeable.
14 Wednesday, .	29·780	56	29·789	54·9	53·6	55·0	53·8	54·4	56·8	110·4	51·2	S. E.	·470	Breezy, cold, showery.
15 Thursday, .	29·870	61	29·861	56·8	55·4	59·4	53·0	54·0	56·4	83·0	50·4	S. E.	·000	Heavy rain, changeable.
16 Friday, .	30·088	64	30·075	63·9	57·8	64·8	50·6	56·2	57·6	128·4	46·2	S. E.	·000	Fine, breezy, bright sun.
17 Saturday, .	30·014	67	29·993	66·2	59·2	66·7	42·9	56·0	58·0	129·0	41·0	S. E.	·000	Do.
18 Sunday, .	29·834	59	29·833	57·6	56·2	58·4	46·9	55·2	57·4	127·4	43·8	S. E.	·210	Breezy, cloudy, heavy showers.
19 Monday, .	29·866	66	29·847	64·1	62·1	66·0	56·1	57·6	58·3	107·0	57·1	S. E.	·010	Cloudy, light showers, occasional sun.
20 Tuesday, .	29·960	70	29·949	68·1	62·9	69·0	55·0	58·0	60·0	126·4	51·2	S. E.	·000	Do.
21 Wednesday, .	30·010	72	29·973	70·6	63·9	71·4	57·0	59·2	61·4	130·2	56·0	S. E.	·000	Fine, overcast, occasional sun.
22 Thursday, .	29·834	63	29·828	61·0	58·6	62·0	55·9	58·8	60·4	144·1	53·2	S. E.	·680	Thunder & lightning, heavy rain & hail showers, occas. sun.
23 Friday, .	29·630	61	29·629	59·6	57·6	60·4	53·4	57·2	59·2	86·6	48·2	S. E.	·180	Cloudy, heavy showers, changeable.
24 Saturday, .	29·714	62	29·708	61·0	54·0	61·8	44·0	53·0	58·0	126·4	41·0	N. W.	·320	Breezy, cloudy, heavy showers, occasnl. sun.
25 Sunday, .	29·956	59	29·960	56·1	52·0	58·4	44·0	53·2	56·4	134·0	39·0	S. W.	·040	Breezy, light showers, occasional sun.
26 Monday, .	30·294	67	30·273	66·8	57·2	67·0	42·4	53·4	56·8	142·6	39·2	S. W.	·000	Fine, breezy, bright sun.
27 Tuesday, .	30·356	62	30·348	60·4	57·6	61·4	50·8	55·0	57·2	128·0	46·0	S. E.	·020	Cloudy, light showers, occasional sun.
28 Wednesday, .	30·362	70	30·331	69·0	61·2	69·8	51·0	57·0	58·4	127·8	44·4	S. E.	·000	Fine, breezy, bright sun.
29 Thursday, .	30·264	74	30·222	72·8	65·2	74·0	47·0	57·0	58·9	124·4	42·2	N. E.	·010	Do.
30 Friday, .	30·352	65	30·339	64·2	60·0	64·8	50·0	56·4	58·6	138·6	44·6	N. E.	·000	Breezy, cloudy, light showers, occasnl. sun.
31 Saturday, .	30·290	66	30·269	65·0	56·4	65·4	40·4	55·0	57·4	126·0	41·8	N. E.	·000	Breezy, cloudy, occasional sun.
													2·870	

AUGUST, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.		In hes.	°	°	°	°	°	°	°	°		Inches.	
1 Sunday,	30·270	70	30·239	69·4	62·4	70·2	46·2	57·0	58·6	130·4	41·2	N.E.	·000	Fine, breezy, bright sun.
2 Monday,	30·250	71	30·229	68·9	60·8	70·0	47·9	57·0	58·2	134·0	44·2	S.W.	·170	Cloudy, mild, occasional sun.
3 Tuesday,	30·176	67	30·070	65·9	60·6	66·0	56·4	57·4	59·2	122·0	53·8	S.E.	·000	Fine, breezy, bright sun, light showers.
4 Wednesday,	30·170	68	30·144	66·9	61·2	67·0	49·6	58·2	60·4	130·2	46·0	S.E.	·000	Do.
5 Thursday,	30·214	66	30·193	65·8	59·2	66·2	44·0	57·0	59·4	126·2	41·4	S.E.	·000	Do.
6 Friday,	30·148	61	30·145	60·0	57·0	60·4	49·8	56·6	58·2	112·0	44·0	N.E.	·020	Cloudy, rain-like, changeable.
7 Saturday,	30·100	62	30·092	60·9	58·0	61·2	57·2	57·0	59·0	89·2	55·0	N.E.	·500	Cloudy, showery, changeable,
8 Sunday,	30·050	70	30·039	63·8	64·2	69·4	57·2	53·0	60·2	118·0	46·4	S.E.	·080	Breezy, cloudy, occasional sun.
9 Monday,	29·670	63	29·664	59·9	59·0	60·9	57·0	58·0	60·4	128·6	53·4	S.E.	·460	Cloudy, heavy showers, changeable.
10 Tuesday,	29·624	64	29·612	62·6	60·6	65·6	56·0	58·0	59·8	104·6	53·0	S.E.	·120	Cloudy, showery, occasional sun.
11 Wednesday,	29·854	70	29·825	67·8	62·4	69·4	53·2	58·4	60·0	127·4	49·0	S.E.	·000	Breezy, cloudy, occasional sun.
12 Thursday,	29·764	64	29·756	62·2	61·0	63·2	53·0	57·4	60·0	121·6	48·2	S.W.	·140	Cloudy, showery, changeable.
13 Friday,	29·864	70	29·833	68·0	63·2	69·4	58·0	59·6	61·4	115·8	56·0	S.W.	·170	Breezy, cloudy, occasional sun.
14 Saturday,	30·022	74	29·980	72·4	64·0	73·2	56·0	60·0	62·0	122·4	52·8	S.W.	·000	Breezy, showery, bright sun.
15 Sunday,	30·118	71	30·087	69·2	65·0	70·2	54·8	60·0	61·4	114·0	51·0	S.W.	·000	Fine, breezy, bright sunshine.
16 Monday,	29·894	71	29·863	69·9	65·0	70·0	61·4	60·8	62·0	114·6	58·9	S.E.	·010	Breezy, cloudy, light showers.
17 Tuesday,	29·858	70	29·802	75·6	65·0	75·8	63·2	62·0	63·0	110·0	59·0	S.W.	·000	Fine, breezy, bright sun.
18 Wednesday,	30·046	71	30·015	70·0	61·0	70·8	57·6	60·4	62·2	124·8	53·4	S.W.	·000	Breezy, cloudy, occasional sun.
19 Thursday,	30·252	68	30·246	66·1	52·0	67·4	49·4	58·6	61·2	122·0	45·4	N.E.	·000	Fine, breezy, bright sun.
20 Friday,	30·284	69	30·253	67·8	60·2	68·6	47·6	57·8	60·4	119·0	43·9	S.W.	·000	Breezy, cloudy, occasional sun.
21 Saturday,	30·302	71	30·271	70·2	63·8	71·0	54·0	59·0	60·8	134·0	49·5	S.W.	·000	Fine, breezy, bright sun.
22 Sunday,	30·240	73	30·213	72·2	65·4	72·8	58·0	60·0	61·6	134·6	54·9	S.W.	·000	Breezy, cloudy, bright sun.
23 Monday,	30·010	71	29·979	69·2	65·4	70·4	55·0	59·4	61·2	138·0	49·6	S.W.	·040	Do.
24 Tuesday,	29·882	69	29·858	67·2	61·8	68·6	58·4	59·2	61·4	127·0	57·8	S.W	·000	Cloudy, showery, occasional sun.
25 Wednesday,	29·686	73	29·651	72·0	65·9	72·4	59·8	60·0	62·0	128·6	57·6	S.W.	·000	Breezy, cloudy, occasional sun.
26 Thursday,	29·868	64	29·849	65·2	61·4	65·8	56·4	59·0	61·2	128·0	51·4	S.W.	·000	Do.
27 Friday,	30·114	66	30·093	64·4	59·6	65·4	51·0	57·2	59·8	124·8	44·9	S.W.	·000	Do.
28 Saturday,	30·070	67	30·049	65·0	59·8	66·0	55·2	58·0	60·0	123·0	54·0	S.E.	·020	Breezy, light showers, bright sun.
29 Sunday,	29·970	70	29·939	69·8	63·6	69·8	51·2	57·8	60·0	133·0	46·9	S.W.	·140	Breezy, showery, bright sun.
30 Monday,	30·022	64	30·009	62·6	57·9	63·2	52·0	56·0	58·0	124·0	49·2	S.W.	·090	Breezy, cloudy, occasional sun.
31 Tuesday,	30·154	67	30·133	65·4	58·2	66·4	48·6	55·8	68·4	132·0	45·0	S.W.	·000	Breezy, showery, bright sun.
													1·960	

SEPTEMBER, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers 5 Inch.	Earth Thermometers 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Wednesday .	30·218	70	30·187	68·4	63·0	69·0	55·0	57·6	59·2	126·0	50·8	S.E.	·080	Cloudy mild, occasional sun.
2 Thursday, .	29·950	70	29·919	69·6	67·0	70·4	54·4	59·0	60·8	115·6	49·8	S.E.	·320	Cloudy, showery, occasional sun.
3 Friday, .	29·950	47	29·929	62·4	59·6	63·2	55·6	58·0	60·6	129·0	53·2	S.W.	·000	Do.
4 Saturday, .	30·104	65	30·089	64·2	60·6	64·8	54·9	57·0	59·6	129·4	52·4	S.W.	·010	Breezy, light showers, occasional sun.
5 Sunday, .	30·300	66	30·279	65·0	60·2	65·9	58·0	57·8	59·6	124·0	55·6	S.W.	·000	Cloudy, mild, overcast.
6 Monday, .	30·254	68	30·228	66·3	64·4	67·4	53·0	58·0	60·0	128·4	44·2	S.E.	·000	Do.
7 Tuesday, .	29·950	70	29·919	63·2	64·0	69·6	59·4	59·2	60·6	118·6	53·8	S.E.	·000	Breezy, cloudy, occasional sun.
8 Wednesday,.	29·920	62	29·912	60·8	54·2	61·4	55·0	57·4	60·0	113·0	52·0	S.E.	·000	Do.
9 Thursday, .	29·782	63	29·767	61·8	57·0	62·2	41·0	55·0	58·0	124·0	36·8	S.E.	·260	Breezy, light showers, occasional sun.
10 Friday, .	29·958	62	29·959	60·4	56·0	61·4	46·0	54·0	56·4	117·0	40·4	S.E.	·000	Cloudy, showery, occasional sun.
11 Saturday, .	30·288	69	30·257	67·8	59·2	68·6	42·2	54·0	56·4	118·0	38·8	S.E.	·000	Fine, breezy, bright sun.
12 Sunday, .	30·416	68	30·390	66·9	61·2	67·0	40·0	54·2	56·0	118·0	37·2	S.E.	·000	Do.
13 Monday, .	30·340	69	30·314	67·6	63·8	68·6	46·2	55·4	57·2	119·0	42·4	N.E.	·000	Do.
14 Tuesday, .	30·340	68	30·314	66·8	62·8	67·4	49·9	56·8	58·2	120·6	43·2	S.E.	·000	Do.
15 Wednesday,.	30·274	64	30·253	64·4	61·6	65·6	55·2	57·0	58·6	119·0	51·0	S.E.	·000	Breezy, cloudy, occasional sun.
16 Thursday, .	30·148	66	30·127	65·0	62·0	66·0	55·8	57·4	59·0	114·0	51·4	S.E.	·000	Do.
17 Friday, .	30·090	71	30·059	69·0	65·8	70·6	55·6	58·0	59·2	120·6	49·8	S.E.	·010	Fine, mild, bright sun.
18 Saturday, .	30·102	62	30·094	61·2	60·2	61·8	53·4	57·0	58·6	113·0	49·2	S.E.	·340	Cloudy, light rain, changeable.
19 Sunday, .	29·970	64	29·957	68·1	60·4	63·9	57·6	57·0	59·0	98·0	54·2	S.E.	·020	Cloudy, heavy showers, with flashes of lightning.
20 Monday, .	29·910	68	29·884	66·4	63·0	67·4	50·9	57·0	59·0	120·0	48·8	S.E.	·010	Cloudy, light showers, occasional sun.
21 Tuesday, .	29·882	63	29·816	61·2	59·2	62·0	47·0	56·0	58·2	115·0	43·8	S.E.	·610	Cloudy, light showers, changeable.
22 Wednesday,.	29·844	58	29·848	57·0	55·8	58·0	56·8	56·0	58·4	74·0	53·2	S.E.	·080	Breezy, cloudy, heavy rain.
23 Thursday, .	29·998	57	30·006	55·6	55·2	56·2	54·0	55·0	57·0	65·0	54·0	S.E.	·650	Breezy, showery, changeable.
24 Friday, .	29·832	61	29·831	59·0	58·0	60·0	55·8	55·3	57·2	65·0	55·4	S.E.	·300	Breezy, heavy rain, occasional sun.
25 Saturday, .	29·858	63	29·850	61·8	55·2	62·4	56·0	56·0	58·0	119·4	55·0	S.W.	·010	Breezy, light showers, occasional sun.
26 Sunday, .	29·460	64	29·450	63·0	61·9	65·9	54·3	56·1	57·9	113·0	54·8	S.W.	·370	Stormy, heavy showers, occasional sun.
27 Monday, .	29·780	60	29·779	58·4	52·4	59·0	47·2	52·4	55·6	114·0	47·2	S.W.	·100	Do.
28 Tuesday, .	29·780	58	29·784	56·4	53·6	57·6	53·0	52·0	55·0	104·0	53·0	S.W.	·000	Breezy, cold, changeable.
29 Wednesday,.	29·846	61	29·845	60·2	53·6	60·4	42·6	52·0	54·2	109·4	42·6	S.W.	·000	Fine, breezy, bright sun.
30 Thursday, .	30·066	64	30·047	62·8	56·6	63·2	44·6	51·4	54·0	114·8	44·6	S.E.	·090	Do.
													3·260	

OCTOBER, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Friday, .	29·780	69	29·751	68·4	61·6	68·4	52·8	53·8	55·2	123·0	52·8	S.E.	·000	Breezy, showery, bright sun.
2 Saturday, .	29·726	54	29·742	54·2	50·2	54·0	45·2	51·0	53·8	116·0	45·2	S.W.	·060	Do.
3 Sunday, .	29·562	61	29·561	60·2	57·4	60·9	47·0	50·8	53·0	111·0	41·0	S.W.	·080	Breezy, showery, occasional sun.
4 Monday, .	29·730	64	29·718	63·9	60·4	64·0	51·8	53·0	54·2	102·0	48·6	S.W.	·030	Breezy, cloudy, changeable.
5 Tuesday, .	29·914	59	29·913	57·2	52·0	58·0	54·0	53·4	55·0	112·2	49·0	S.W.	·000	Breezy, showery, occasional sun.
6 Wednesday, .	30·400	60	30·397	59·0	53·4	59·8	45·8	50·8	53·4	115·6	41·2	S.W.	·000	Breezy, bright sun, changeable.
7 Thursday, .	30·290	62	30·282	60·8	56·4	61·4	51·2	52·0	63·9	120·0	46·6	S.W.	·000	Do.
8 Friday, .	29·818	61	29·817	60·6	55·0	60·8	60·4	52·2	54·0	115·0	44·0	S.E.	·230	Breezy, light showers, changeable.
9 Saturday. .	29·802	56	29·811	54·0	49·6	55·4	39·6	49·2	52·4	110·0	36·8	S.W.	·000	Fine, breezy, bright sun.
10 Sunday, .	29·670	54	29·686	52·6	49·2	53·0	33·2	47·0	50·2	109·2	31·4	S.W.	·030	Breezy, cloudy, occasional sun.
11 Monday, .	29·216	54	29·233	52·8	48·0	53·2	40·2	47·0	50·0	120·0	36·4	S.W.	·000	Breezy, showery, bright sun.
12 Tuesday, .	29·342	53	29·364	52·2	47·0	52·9	35·4	45·2	48·8	115·2	31·6	S.W.	·060	Breezy, cold, bright sunshine.
13 Wednesday,	29·258	50	29·280	49·2	46·8	49·8	34·2	44·4	47·2	113·4	31·6	N.E.	·110	Cloudy, cold, light showers.
14 Thursday, .	29·512	52	29·533	51·0	47·4	51·6	31·6	43·2	46·6	106·0	30·0	N.W.	·020	Breezy, showery, bright sun.
15 Friday, .	29·700	55	29·715	53·2	50·6	54·2	48·0	46·2	47·8	102·4	44·0	N.E.	·070	Do.
16 Saturday, .	29·678	54	29·694	53·0	49·2	53·9	41·0	46·4	48·6	114·0	36·6	S.E.	·220	Breezy, showery, occasional sun.
17 Sunday, .	29·760	59	29·757	57·0	52·0	58·2	40·2	47·0	49·2	118·0	33·9	S.E.	·020	Breezy, bright sun, heavy rain.
18 Monday, .	29·080	54	29·696	53·0	51·0	53·6	47·2	48·0	49·6	110·0	43·0	S.E.	1·050	Breezy, showery, changeable.
19 Tuesday, .	29·608	55	29·624	53·8	52·0	54·6	49·0	48·4	50·2	66·4	47·2	S.E.	·150	Breezy, heavy rain, changeable.
20 Wednesday,	29·444	53	29·466	52·1	51·6	52·8	51·4	49·0	50·6	72·0	50·0	S.E.	·140	Cloudy, showery, changeable.
21 Thursday, .	29·324	61	29·324	59·0	54·6	60·2	50·0	50·0	51·4	108·0	45·2	S.E.	·210	Breezy, showery, occasional sun.
22 Friday, .	29·308	58	29·314	56·4	51·8	57·0	46·2	49·4	51·0	102·0	39·9	S.W.	·000	Do.
23 Saturday, .	29·552	55	29·567	53·9	54·2	54·2	39·9	48·0	50·0	112·0	35·4	S.E.	·020	Breezy, cloudy, occasional sun.
24 Sunday, .	30·006	55	30·011	54·0	51·6	54·8	44·0	48·0	56·0	84·0	38·9	S.E.	·000	Do.
25 Monday, .	29·992	54	30·001	54·0	52·2	55·0	50·2	48·4	50·2	77·0	45·6	S.E.	1·390	Breezy, cloudy, changeable.
26 Tuesday, .	29·578	50	29·604	48·9	47·8	49·6	49·2	48·0	50·0	69·0	48·8	S.E.	1·780	Breezy, heavy rain.
27 Wednesday,	29·632	47	29·663	46·2	45·6	46·8	46·0	47·0	49·0	62·4	46·2	S.E.	·790	Do.
28 Thursday, .	29·894	47	29·824	45·9	45·4	46·2	44·0	46·0	48·0	71·0	44·0	S.E.	·190	Cloudy, very cold, heavy showers.
29 Friday, .	29·986	50	30·011	49·2	46·8	49·8	45·0	45·8	48·0	57·0	44·8	S.E.	·360	Breezy, showery, changeable.
30 Saturday, .	29·800	48	29·831	46·8	45·0	47·0	45·8	45·2	57·4	55·0	44·0	S.E.	·100	Do.
31 Sunday, .	29·760	49	29·786	48·2	47·6	48·9	45·6	45·4	47·2	56·0	45·4	S.E.	·030	Breezy, cold, changeable.
													7·140	

NOVEMBER, 1875.

Date.	Barometer.			Thermometer.								Wind.	Rain.	Remarks.
	Uncorrected.	Attached Thermometer.	Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers.				Earth Thermometers.		Grass Thermometers freely exposed.		Direction.	Previous 24 Hours.	
				Dry B.	Wet B.	Max.	Min.	5 Inch.	10 Inch.	Max.	Min.			
	Inches.	°	Inches	°	°	°	°	°	°	°	°		Inches.	
1 Monday,	29·704	49	29·730	48·6	47·4	48·2	47·0	46·0	47·6	77·8	46·2	S.E.	·240	Breezy, cold, changeable.
2 Tuesday,	29·530	58	29·534	55·8	55·2	36·4	49·0	48·0	49·2	64·0	43·9	S·E	·020	Breezy, cloudy, showery.
3 Wednesday,	29·550	62	29·544	60·0	56·9	61·6	55·0	50·0	51·2	98·0	52·0	S.W.	·000	Cloudy, mild, occasional sun.
4 Thursday,	29·700	58	29·704	57·2	55·0	57·6	50·6	50·0	51·0	90·2	47·8	S.W.	·140	Breezy, cloudy, light showers.
5 Friday,	29·630	59	29·629	58·0	57·0	58·6	47·0	50·0	51·0	82·4	42·2	S.W.	·210	Breezy, showery, changeable.
6 Saturday,	29·146	54	29·163	52·6	50·4	53·2	49·8	49·4	51·0	90·0	47·2	S.W.	·000	Breezy, showery, occasional sun.
7 Sunday,	29·392	47	29·430	45·8	42·2	46·4	38·2	45·4	48·2	83·4	35·6	S.W.	·000	Breezy, cloudy, occasional sun.
8 Monday,	29·442	45	29·489	43·9	40·6	44·2	32·8	42·4	46·0	106·0	30·4	S.W.	·000	Do.
9 Tuesday,	29·208	42	29·258	40·8	38·0	41·0	28·0	40·0	43·6	84·0	25·0	S.E.	·190	Breezy, cloudy, sharp frost.
10 Wednesday,	29·120	44	29·165	42·4	40·0	43·0	35·4	40·6	43·2	74·0	34·0	N.W.	·000	Cloudy, showery, occasional sun.
11 Thursday,	29·374	43	29·424	42·0	38·0	42·8	30·4	39·0	42·0	78·2	28·4	N.W.	·000	Breezy, occasional sun, changeable.
12 Friday,	29·872	47	29·908	45·4	43·0	46·4	33·8	39·6	42·0	72·6	31·0	N.W.	·400	Do.
13 Saturday,	29·380	44	29·425	43·0	41·4	43·8	37·6	40·0	42·0	67·0	31·0	S.E.	1·300	Breezy, showery, changeable.
14 Sunday,	29·562	47	29·599	45·9	43·0	46·2	41·8	41·6	42·8	59·8	40·0	N.W.	·020	Breezy, cloudy, heavy rain.
15 Monday,	30·102	43	30·145	41·8	40·6	42·0	31·0	39·0	42·0	73·0	28·0	S.W.	·000	Cloudy, cold, occasional sun.
16 Tuesday,	29·656	51	29·682	49·2	48·0	50·0	40·8	41·6	43·0	55·6	36·0	S.W.	·190	Breezy, showery, changeable.
17 Wednesday,	29·750	53	29·771	52·4	51·2	53·0	44·2	42·6	44·0	79·0	37·6	S.W.	·200	Do.
18 Thursday,	30·018	57	30·026	56·1	52·8	56·8	53·0	47·2	48·8	62·8	50·4	S.W.	·000	Breezy, showery, occasional sun.
19 Friday,	29·882	51	29·908	50·9	47·0	50·4	49·0	46·0	47·8	84·4	45·0	—	·020	Heavy storm, light showers, changeable.
20 Saturday,	30·262	46	30·298	44·8	39·8	45·2	38·2	43·0	45·2	76·0	34·6	—	·000	Fine, breezy, bright sun.
21 Sunday,	30·174	46	30·210	45·0	41·0	45·8	32·0	40·0	43·0	77·0	28·6	—	·030	Breezy, showery, occasional sun.
22 Monday,	30·326	46	30·362	44·2	40·0	45·4	40·0	40·6	42·4	79·2	34·6	—	·040	Breezy, cloudy, occasional sun.
23 Tuesday,	30·320	44	30·363	42·0	40·0	43·0	38·9	40·0	42·0	57·8	36·0	—	·200	Breezy, showery, occasional sun.
24 Wednesday,	30·216	45	30·259	43·8	40·4	44·6	37·6	39·4	41·6	89·6	32·4	—	·000	Breezy, hail showers, occasional sun.
25 Thursday,	30·194	43	30·243	42·2	38·9	42·8	38·9	39·0	41·2	69·4	36·2	—	·060	Breezy, cold, occasional sun.
26 Friday,	30·022	38	30·081	36·0	35·0	37·2	23·0	37·4	40·2	78·0	29·9	—	·940	Breezy, hail showers, occasional sun.
27 Saturday,	30·130	42	30·179	41·9	38·6	42·0	31·0	36·2	39·0	77·0	28·8	—	·030	Do.
28 Sunday,	30·200	42	29·249	40·8	37·2	41·6	39·0	37·4	39·2	63·0	33·0	—	·040	Breezy, light showers.
29 Monday,	30·128	40	29·182	40·0	38·2	39·1	41·3	37·6	39·6	51·6	33·0	—	·140	Cloudy, showers of hail, occasional sun.
30 Tuesday,	30·008	36	30·073	35·2	34·6	35·8	34·0	36·0	37·4	46·0	31·9	—	·260	Breezy, cloudy, snow showers.
													4·700	

DECEMBER, 1875.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Wednesday,	30·036	41	30·090	39·2	35·8	40·0	33·6	36·8	38·2	68·2	31·6	—	·000	Breezy, cloudy, snow showers.
2 Thursday,	29·978	41	30·032	39·2	36·0	40·4	29·0	35·2	38·0	82·0	25·8	—	·000	Breezy, bright sun.
3 Friday,	29·942	38	29·996	36·2	34·6	37·2	32·4	35·0	37·0	78·5	29·9	—	·000	Breezy, snow showers, occasional sun.
4 Saturday,	29·944	39	29·998	39·0	36·8	39·2	28·4	34·0	37·0	79·0	25·2	—	·000	Cloudy, occasional sun, sharp frost.
5 Sunday,	30·090	35	30·155	34·1	32·0	35·8	34·8	33·2	25·4	82·0	24·0	—	·060	Cloudy, heavy snow showers, sharp frost
6 Monday,	30·290	36	30·355	35·0	32·6	35·8	22·4	32·4	34·6	42·9	20·0	—	·200	Do.
7 Tuesday,	30·466	38	30·525	36·8	34·4	37·0	34·0	33·2	35·0	44·0	32·0	—	·000	Breezy, cloudy, changeable.
8 Wednesday,	30·514	38	30·573	36·2	32·0	37·2	28·4	33·0	35·4	82·4	26·0	—	·000	Fine, bright sun, sharp frost.
9 Thursday,	30·440	36	30·505	34·4	32·9	35·0	24·0	31·6	34·2	82·0	21·9	—	·000	Do.
10 Friday,	30·358	34	30·430	33·0	31·6	33·8	24·8	31·2	34·0	72·0	21·6	—	·000	Do.
11 Saturday,	30·208	41	30·262	39·8	38·2	40·6	29·4	32·4	34·6	74·0	27·4	—	·000	Breezy, cloudy, occasional sun.
12 Sunday,	30·142	48	30·173	46·0	42·6	47·2	33·9	34·0	35·2	75·0	28·6	—	·000	Fine, mild, bright sun.
13 Monday,	30·080	48	30·111	46·8	43·2	47·4	37·0	35·0	36·2	77·0	31·8	—	·000	Cloudy, mild, occasional sun.
14 Tuesday,	29·940	47	29·977	45·8	42·1	46·2	30·4	35·0	37·0	72·0	26·0	S.E.	·000	Breezy, occasional sun, changeable.
15 Wednesday,	29·994	48	30·025	46·2	44·0	49·0	37·8	36·0	37·2	70·6	30·4	S.E.	·000	Do.
16 Thursday,	29·998	45	30·040	44·9	43·4	45·0	34·4	36·0	37·4	58·0	31·0	S.E.	·000	Cloudy, heavy fog, changeable.
17 Friday,	29·752	50	29·778	49·4	46·8	49·8	40·8	37·2	38·6	80 0	33·4	S.E.	·100	Breezy, cloudy, occasional sun.
18 Saturday,	29·664	48	29·695	47·0	45·0	47·6	43·0	39·4	40·6	66·2	35·6	S.W.	·020	Cloudy, showery, occasional sun.
19 Sunday,	29·422	47	29·453	46·0	42·9	46·8	35·6	38·0	39·6	80·0	29·8	S.W.	·080	Breezy, cloudy, occasional sun.
20 Monday,	29·360	59	29·360	57·9	53·8	48·2	38·2	40·3	41·0	90·0	33·4	S.W.	·090	Fine, breezy, bright sun.
21 Tuesday,	29·588	49	29·614	49·0	45·4	49·0	38·0	39·4	40·6	93·4	34·0	S.W.	·500	Breezy, light showers, occasional sun.
22 Wednesday,	29·308	48	29·335	47·0	42·6	47·6	42·2	41·0	42·4	77·0	38·0	S.W.	·060	Do.
23 Thursday,	29·868	49	29·894	47·2	44·0	48·2	38·0	39·0	41·0	78·6	39·0	S.W.	·020	Do.
24 Friday,	29·844	50	29·870	49·0	47·6	49·6	38·2	41 0	42·4	79·0	36·2	S.W.	·130	Stormy, heavy showers.
25 Saturday,	30·300	48	30·325	47·0	45·0	47·9	40·0	39·9	42·4	72·4	34·6	S.W.	·000	Breezy, showery, occasional sun.
26 Sunday,	30·320	51	30·345	50·0	47·4	50·6	43·0	41·0	42·4	73·0	37·0	S.W.	·000	Breezy, cloudy, occasional sun.
27 Monday,	30·218	50	30·243	49·0	46·2	50·0	41·2	41·0	42·4	85·0	34·3	S.W.	·040	Do.
28 Tuesday,	30·382	57	30·407	49·4	47·0	50·2	43·0	41·6	42·6	74·2	38·4	S.W.	·000	Breezy, cloudy, light showers.
29 Wednesday,	30·270	52	30·290	50·8	48·0	51·2	46·0	42·0	43·2	67·0	39·9	S.W.	·000	Fine, breezy, occasional sunshine.
30 Thursday,	30·100	50	30·125	49·0	45·4	49·8	46·8	42·6	43·4	76·2	37·4	S.E.	·000	Do.
31 Friday,	29·670	54	29·686	53·6	50·9	54·0	48·0	43·2	43·9	70·2	41·9	S.W.	·100	Breezy, showery, bright sun.
													1·400	

RAINFALL in 1875, at the BOTANIC GARDENS, GLASNEVIN, COUNTY DUBLIN.

MONTH.	Total Depth.	Greatest Fall in 24 Hours.		Number of Days on which ·01 or more fell
	Inches.	Depth in inches.	Date.	
January, . . .	1·890	·430	19th	21
February, . . .	2·830	·620	20th	17
March, . . .	·890	·400	5th	12
April, . . .	·760	·380	26th	6
May, . . .	·930	·190	27th	11
June, . . .	3·550	·670	11th	19
July, . . .	2·870	·680	22nd	17
August, . . .	1·960	·500	7th	13
September, . .	3·260	·650	23rd	16
October, . . .	7·140	1·780	26th	23
November, . .	4·700	1·300	13th	20
December, . .	1·400	·500	21st	12
Total, .	32·180	—	—	187

RAINFALL in 1875, at 40, FITZWILLIAM-SQUARE, WEST, DUBLIN, in the COUNTY of the CITY of DUBLIN, observed by J. W. MOORE, M.D., DUB., F.K.Q.C.P.

Rain Gauge, { Diameter of Funnel, 5 inches.
Height of Top above Ground, 3 feet 4 inches.
" " Sea Level, 54 feet.

MONTH.	Total Depth.	Greatest Fall in 24 Hours.		Number of Days on which ·01 or more fell.
	Inches.	Depth in inches.	Date.	
January, . . .	2·141	·279	17th	23
February, . .	2·477	·702	20th	17
March, . . .	1·040	·535	5th	14
April, . . .	1·008	·563	26th	12
May, . . .	1·071	·231	21st	15
June, . . .	2·989	·636	11th	20
July, . . .	2·751	·506	14th	18
August, . . .	1·883	·748	9th	14
September, . .	3·180	·610	21st	14
October, . . .	7·049	1·355	26th	26
November, . .	3·051	·934	13th	19
December, . .	1·310	·440	21st	13
Total, . .	29·950	—	—	205

Remarks.—October, 1875, will long be remembered for its excessive and persistent rainfall (7·049 inches on 26 days!) During the past 11 years the heaviest monthly rainfalls in Dublin have occurred in October, 1864 (5·255 inches), March, 1867 (4·972), August, 1868 (4·745), December, 1868 (4·749), January, 1869 (4·258), May, 1869 (5·414), October, 1870 (5·194), July, 1871 (4·391), September, 1871 (4·048), August, 1872 (4·303), December, 1872 (4·932), August, 1874 (4·946), and October, 1875 (7·049 inches). The heaviest rainfall in 24 hours during the same period was 2·482 inches on August 13, 1874. From the 18th to the 31st, inclusive, 5·897 inches of rain fell at 40, Fitzwilliam-square, West, Dublin. The cause of this remarkable downpour was the existence of an almost stationary area of *high* barometrical pressure, with severe cold, over Scandinavia and Russia. This high pressure opposed the passage eastwards, across the British Islands, of cyclonic systems, while the cold precipitated the moisture abounding in these areas of depression. From the 9th the barometer was uniformly high in the N.E. of Sweden, and the high pressure travelled southward down the Baltic coasts. Intense cold for the time of year set in near the centre of highest pressure on the 18th, the 8 a.m. temperatures at Haparanda (Gulf of Bothnia) being, from the 18th to the 29th, 28°, 24°, 19°, 22°, 22°, 15°, 21°, 28° 27°, 19°, 22°.

J. W. MOORE, M.D.

TABLES OF RAINFALL IN IRELAND.

COMPILED AND KINDLY FURNISHED BY WILLIAM ROBERT MAGUIRE, ESQ.

DISTRICT.	COUNTY.	Height above Sea Level.	Height of Rain Gauge.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	Mean Rain-fall.	Series of Years.	No. of Years.
		′	′ ″																
Dublin City,	Co. Dublin,	54	1	–	–	–	27·5	25·9	27·2	24·9	27·6	20·9	25·3	35·5	23·8	27·1	26·5	1865–74	10
Phœnix Park,	Co. Dublin,	170	3	–	–	–	26·3	26·6	24·0	24·5	28·5	21·4	28·2	35·8	25·5	27·8	27·0	1865–74	10
Glasnevin,	Co. Dublin,	66	6	28·0	26·1	24·0	24·3	–	–	23·5	26·1	–	25·0	38·2	24·6	26·3	26·5	1862–74	10
Blackrock,	Co. Dublin,	95	29″	24·9	23·0	25·7	29·8	27·5	26·1	32·6	29·6	25·0	28·1	42·3	23·0	39·2	29·0	1862–74	13
Monkstown,	Co. Dublin,	100	6″	31·3	27·4	29·0	32·1	28·1	27·4	30·6	28·1	23·5	25·7	37·5	24·9	28·1	29·0	1862–74	13
Balbriggan,	Co. Dublin,	57	1	–	–	–	–	–	–	29·9	31·1	28·9	31·5	43·2	27·0	31·3	31·8	1868–74	7
Bray,	Co. Wicklow,	250	5	45·8	35·8	31·6	42·2	38·2	35·2	41·7	38·9	33·1	33·2	50·5	27·7	31·4	37·7	1862–74	13
Ashford,	Co. Wicklow,	249	–	–	–	–	–	–	–	–	–	–	–	56·0	29·3	32·5	39·3	1872–74	3
N. T. Mt. Kennedy,	Co. Wicklow,	160	1	–	–	–	–	–	–	–	–	–	–	–	–	28·0	28·0	1874	1
Shillelagh,	Co. Wicklow,	427	1	–	–	–	–	–	–	–	–	18·8	–	50·8	28·3	–	32·6	1870–73	3
Wexford,	Co. Wexford,	1	2″	–	36·7	34·5	36·6	31·3	27·7	34·3	33·1	25·2	38·0	65·8	33·5	38·2	35·8	1863–74	12
New Ross,	Co. Wexford.	60	2	–	–	–	–	30·0	32·4	44·7	38·7	32·3	37·7	63·9	39·3	34·4	39·3	1866–74	9
Enniscorthy,	Co. Wexford,	420	1	–	–	–	–	–	38·3	47·0	41·9	32·6	47·4	57·2	41·2	34·4	42·5	1867–74	8
Courtown,	Co. Wexford,	80	3	–	–	–	–	34·4	33·6	–	34·0	30·3	37·6	52·1	29·5	33·7	35·6	1866–74	8
Carlow,	Co. Carlow,	291	1	–	–	–	–	30·8	29·7	38·6	35·8	28·2	33 1	47·3	31·0	33·9	34·2	1866–74	9
Bagenalstown,	Co. Carlow,	340	1	–	–	–	–	31·7	32·8	37·1	32·4	29·1	33·9	51·9	32·0	32·8	34·7	1866–74	9
Kilkenny,	Co. Kilkenny,	200	6″	–	33·7	35·2	30·4	–	–	–	–	–	–	–	–	–	33·1	1863–5	3
Stoneyford,	Co. Kilkenny,	220	1	–	–	–	29·3	27·9	27·0	32·6	30·9	26·4	32·5	43·9	32·6	29·8	31·3	1865–74	10
Inistiogue,	Co. Kilkenny,	400	4	–	–	–	43·6	–	–	–	–	38·2	46·2	64·0	40·3	39·7	45·3	1865–74	6
New Ross,	Co. Kilkenny,	500	1	–	–	–	–	30·0	32 4	44·7	38·7	39·5	52·0	65·3	44·3	41·5	43·1	1866–74	9
Clonee,	Co. Meath,	200	1	–	–	–	–	–	–	–	–	–	–	38·0	26·3	28·6	31·0	1872–74	3
Athlone,	Co. Westmeath	201	1	–	–	–	–	–	–	–	–	33·7	36·9	49·2	37·4	37·9	39·0	1870–74	5
Castlebellingham,	Co. Louth,	225	1	–	–	–	–	–	–	–	28·2	–	–	–	28·0	30·8	29·0	1869–74	3
Parsonstown,	King's Co.,	–	–	36·3	28·8	27·0	31·9	32·5	28·1	33·6	35·6	28·0	29·6	38·0	36·0	35·7	32·5	1862–74	13
Rathangan,	King's Co.,	224	1	–	–	–	–	–	–	–	–	28·7	30·2	39·9	30·9	32·0	32·5	1870–74	5

TABLES OF RAINFALL IN IRELAND—*continued.*

District.	County.	Height above Sea Level.	Height of Rain Gauge.		1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	Mean Rain-fall.	Series of Years.	No. of Years.
		′	′	″																
Tullamore, . . .	King's Co., .	235	3		–	–	24·0	26·9	26·4	27·5	28·6	28·5	24·9	29·0	35·7	33·1	28·5	28·5	1864–74	11
Roscrea, . . .	King's Co., .	–	–		–	–	–	31·0	29·9	28·0	29·3	31·8	33·0	–	–	–	–	30·5	1865–70	6
Portarlington, . .	Queen's Co., .	240	1		45·1	45·3	42·4	43·8	30 7	29·1	30·4	30·0	26 0	28·5	37·7	29·5	29·0	34·4	1862–74	13
Durrow, . . .	Queen's Co., .	–	–		–	–	–	–	–	–	–	–	28·1	–	–	–	–	28·1	1870	1
Armagh, . . .	Co. Armagh, .	208	1	7	37·1	30·8	27·7	36·0	34·1	32·4	29·6	29·7	22·3	28·4	40·0	26·7	28·7	31·0	1862–74	13
Markethill, . . .	Co. Armagh, .	–	–		–	–	–	–	–	–	–	–	–	–	–	–	32·9	32·9	1874	1
Belturbet, . . .	Co. Cavan, .	208		9	–	–	29·1	36·9	39·1	38·0	36·7	31·9	32·4	36·0	43·1	31·6	32·2	35·2	1864–74	11
Bawnboy, . . .	Co. Cavan, .	218	1	3	–	–	36·8	41·3	49 9	49·7	47·6	43·7	–	–	–	–	–	45·0	1864–69	6
Banbridge, . . .	Co. Down, .	200		8	–	–	25·1	29·2	28·2	31·9	28·1	29·3	27·7	29·8	46·6	27·7	28·5	30·2	1864–74	11
Milltown, . . .	Co. Down, .	440	1		–	–	44·7	52·3	54·6	47·2	43·3	28·9	48·1	43·0	61·2	31·2	28·5	44·0	1864–74	11
Seaford, . . .	Co. Down, .	180		5	–	–	–	–	–	–	40·2	33·6	37·3	34·2	57·6	29·8	32·2	37·8	1868–74	7
Sydenham, . . .	Co. Down, .	60	1		–	–	–	–	–	–	–	–	35·5	32·9	53·0	36·5	38·5	39·3	1870–74	5
Waringtown, . .	Co. Down, .	190		4	34·4	28·4	25·4	28·6	32·0	33·9	29 8	30·4	28·4	30·3	44·7	29·3	29·7	31·2	1862–74	13
Enniskillen, . .	Co. Fermanagh	250	1	9	49·4	42·4	29·4	43·1	50·6	47·0	49·2	44·5	43 0	46·3	60·8	40·3	45·1	45·5	1862–74	13
Letterkenny, . .	Co. Donegal, .	108		6	–	–	46·3	50·5	61·9	54·7	56·6	52·9	49·4	52·6	54·7	47·7	56·2	53·0	1864–74	11
Raphoe, . . .	Co. Donegal, .	100	1		–	–	–	–	–	–	–	–	–	–	50·7	39·9	45·8	45·3	1872–74	3
Dungloe, . . .	Co. Donegal, .	10		6	–	–	–	–	–	41·0	42·8	45·9	39·2	43·6	52·8	47·2	45·7	44·8	1867–74	8
Ramelton, . . .	Co. Donegal, .	21	1	0	–	–	–	–	–	–	–	–	–	–	52·6	40·7	44·3	45·9	1872–74	3
Moville, . . .	Co. Donegal, .	100	4		–	–	–	–	–	–	–	–	39·8	41·1	57·5	42·2	44·4	45·0	1870–74	5
Garvagh, . . .	Co. Londonderry	121	1		–	–	31·8	37·9	41·8	40·2	38·8	40·0	33·9	38·3	55·0	36·0	40·3	39·4	1864–74	11
Ballarena, . . .	Co. Londonderry	12	1		–	–	–	–	38·5	37·8	33·9	36·7	31·0	34·2	47·4	36·8	38·9	37·2	1866–74	9
Londonderry, . .	Co. Londonderry	80		6	–	–	–	39·2	42·0	41·2	36·3	39·8	37·3	37·2	43·7	40·1	44·9	40·2	1865–74	10
Strabane, . . .	Co. Tyrone, .	108		6	42·4	41·7	35·0	38 0	42·6	45·1	39·1	41·8	38·6	37·3	–	–	–	40·2	1862–71	10
Omagh, . . .	Co. Tyrone, .	275	1		–	–	–	–	–	–	32·6	33·3	32·1	31·4	47·3	34·9	35·5	35·3	1868–74	7
Belfast, . . .	Co. Antrim, .	68	7		41·2	38·5	29·9	35·8	35·6	32·7	31·6	32·6	30 1	31 9	44·5	31·1	34 8	34·6	1862–74	13
Antrim, . . .	Co. Antrim, .	150	1		–	–	29·7	29·4	33·0	31·7	26·5	26·7	28·5	32·7	42 0	32·1	29 4	31·1	1864–74	11

Aghalee, . . .	Co. Antrim, .	105	1		–	–	–	–	–		25·2	28·8	28·9	30·2	47·1	32·0	30·0	31·6	1868–74	7
Carrickfergus, . .	Co. Antrim, .	–		–	–	–	–	–	–	–	–	–	30·7	35·0	50·1	35·0	35·6	37·3	1870–74	5
Cork, Queen's College,	Co. Cork, .	65	6		47·3	40·2	34·6	43·0	42·1	42·7	50·3	41·0	35·6	45·4	61·6	36·8	30·5	42·4	1862–74	13
Cork, Royal Institute,	Co. Cork, .	70		50	38·1	34·2	27·6	43·0	35·3	31·7	41·5	32·5	28·5	35·7	41·3	32·7	29·4	34·7	1862–74	13
Glenville, . . .	Co. Cork, .	514	1		–	–	–	–	–	–	–	–	–	54·2	62·6	44·6	46·5	51·9	1871–74	4
Fermoy, . . .	Co. Cork, .	114	1		–	–	–	–	37·3	31·6	38·7	34·7	29·1	35·6	46·6	33·1	35·8	35·8	1866–74	9
Mallow, . . .	Co. Cork, .	205	5		–	–	–	38·6	–	33·9	44·2	39·7	31·4	–	–	–	–	37·3	1865–70	5
Roche's Point, . .	Co. Cork, .	–		–	–	–	–	–	–	–	60·4	42·5	37·8	48·9	60·9	45·8	43·9	48·6	1868–74	7
Dunmanway, . .	Co. Cork, .	–	1		–	–	–	62·3	–	–	–	–	–	–	–	–	–	62·3	1865	1
Waterford, . . .	Co. Waterford,	60	4	6	45·2	37·1	34·5	41·0	36·0	39·1	51·6	37·4	33·5	44·7	56·4	40·3	37·8	41·1	1862–74	13
Portlaw, . . .	Co. Waterford,	50	25		50·1	41·7	40·3	47·2	41·2	41·1	51·8	–	32·4	44·5	55·6	39·2	36·0	40·1	1862–74	12
Curraghmore, . .	Co. Waterford,	–		–	–	–	–	–	–	–	–	–	40·9	56·9	56·7	40·0	36·1	46·0	1870–74	5
Cahirciveen, . .	Co. Kerry, .	12	1		–	–	–	–	–	–	–	–	48·2	58·3	67·0	57·0	55·4	56·2	1870–74	5
Cara Lake, . . .	Co. Kerry, .	125		4	–	–	–	–	–	–	–	–	–	–	68·4	48·3	50·2	55·6	1872–74	3
Valentia, . . .	Co. Kerry, .	30	2		62·2	64·6	47·6	59·1	54·1	52·6	58·2	54·5	47·9	55·8	68·2	54·1	59·6	56·8	1862–74	13
Killarney, . . .	Co. Kerry, .	100		4	–	–	–	–	54·3	50·0	70·6	59·5	69·0	62·7	–	–	62·6	61·2	1866–74	7
Killaloe, . . .	Co. Clare, .	123		5	49·8	52·1	35·6	46·0	51·8	46·9	47·1	50·6	40·8	40·7	53·0	52·8	51·7	47·7	1862–74	13
Ennis, ...	Co. Clare, .	75		2	–	–	28·4	32·1	44·0	–	–	–	–	–	–	–	–	35·0	1864–67	3
Limerick, . . .	Co. Limerick, .	92		6	–	–	30·8	45·2	–	–	–	39·2	–	–	–	–	–	35·0	1864–69	3
Clonmel, . . .	Co. Tipperary,	80		2	–	–	–	40·9	39·4	39·5	–	39·5	33·2	46·8	59·1	40·7	38·1	37·7	1865–74	10
Shinrone, . . .	Co. Tipperary,	267	–		–	–	–	–	–	–	–	–	–	–	–	38·8	35·5	37·0	1873–74	2
Cloughjordan, . .	Co. Tipperary,	447	1		–	–	–	–	–	–	–	–	–	–	–	38·5	36·7	37·6	1873–74	2
Tipperary, . . .	Co. Tipperary,	300	12		–	–	–	40·2	36·1	31·9	39·6	39·8	37·8	–	–	–	–	37·8	1865–70	6
Galway, . . .	Co. Galway, .	30	8		51·6	62·5	58·1	48·9	51·6	48·1	47·8	52·2	44·8	39·7	56·4	48·1	51·8	50·5	1862–71	13
Gort, ...	Co. Galway, .	130	3		–	–	33·9	38·4	38·7	36·9	40·5	42·1	30·0	36·8	44·2	40·7	46·3	39·0	1864–74	11
Tuam, ...	Co. Galway, .	136	6		–	–	–	–	–	–	–	37·2	33·4	35·7	48·3	36·6	41·5	39·0	1869–74	6
Ballinasloe, . .	Co. Galway, .	150		6	–	–	–	–	–	–	–	41·3	34·5	35·8	45·7	42·1	41·5	40·0	1869–74	6
[illegible]	Co. Sligo, .	136		6	39·9	34·7	24·5	–	41·8	42·2	40·7	39·5	32·9	–	–	36·7	–	37·0	1862–73	9
[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	38·2	40·8	52·9	34·3	41·1	41·4	1864–74	11

[redacted]

MONTHLY RAINFALLS.

Belfast, County Antrim.

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The Year.
1862	5·32	1·51	3·25	4·00	3·82	3·09	4·00	2·57	1·33	4·67	3·23	4·39	41·15
1863	4·56	1·15	2·24	2·34	2·78	3·37	0·53	4·08	3·52	7·44	3·70	2·84	38·55
1864*	–	–	–	–	–	–	–	–	–	–	–	–	29·93
1865*	–	–	–	–	–	–	–	–	–	–	–	–	35·78
1866	3·53	2·87	3·43	1·58	1·67	2·53	1·87	3·24	4·97	1·90	4·27	3·70	35·56
1867	3·47	2·67	2·15	3·55	4·15	0·97	4·34	2·23	1·72	4·57	0·76	2·10	32·68
1868	2·86	2·96	3·85	2·56	2·13	3·35	0·57	4·58	1·86	2·31	2·69	2·86	31·58
1869	3·86	4·45	2·08	1·93	1·85	1·29	2·02	1·81	4·96	1·35	4·30	2·67	32·57
1870	2·44	2·65	1·40	1·35	2·64	1·21	1·61	2·09	1·43	9·90	1·03	2·39	30·14
1871	4·38	3·24	1·78	3·22	0·58	0·97	3·86	2·83	3·39	3·08	1·74	1·84	31·91

* No monthly returns for this year.

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

Armagh, County Armagh.

1862	4·67	0·95	3·03	2·76	4·29	3·42	3·99	2·43	1·70	4·77	1·77	3·31	37·09
1863	2·61	0·79	1·70	1·43	1·66	4·16	0·25	3·48	3·91	5·67	3·06	2·02	30·77
1864	1·82	1·33	2·30	1·97	1·86	1·28	1·71	2·23	2·94	2·49	5·66	2·12	27·71
1865	2·92	4·44	2·31	0·99	5·21	0·74	2·48	3·18	0·32	6·09	4·22	3·11	36·01
1866	4·61	2·61	3·10	1·51	1·17	2·17	3·20	3·31	3·60	1·87	3·06	3·90	34·11
1867	3·67	3·06	1·84	3·40	3·88	0·95	4·58	2·44	1·41	4·42	0·90	1·84	32·39
1868	2·61	2·95	3·56	2·54	1·89	0·92	0·89	2·59	1·60	3·08	3·04	4·95	29·62
1869	3·04	4·45	2·28	3·34	2·30	0·99	1·38	1·36	3·53	1·75	2·28	2·97	29·67
1870	2·11	0·79	0·69	0·53	0·55	0·44	1·27	1·65	2·86	7·62	1.49	2·38	22·31
1871	3·48	2·73	0·96	3·21	0·26	1·00	5·54	2·15	3·79	2·71	1·58	1·05	28·41

Extracted from Letter received.

Waterford, County Waterford.

1862	7·34	1·42	4·35	4·86	2·37	3·48	3·48	2·63	3·24	4·32	2·70	5·04	45·23
1863	4·13	1·47	3·67	0·95	1·18	2·18	1·17	4·64	3·82	6·60	4·05	3·24	37·10
1864	3·75	1·77	3·18	1·85	1·67	1·20	1·73	1·53	3·23	5·05	4·91	4·59	34·46
1865	4·29	3·17	1·70	1·10	4·54	0·68	3·62	5·08	0·55	4·07	6·00	6·22	41·02
1866	5·41	2·70	3·51	2·41	1·28	3·93	0·85	3·47	3·96	2·62	2·34	3·37	36·05
1867	3·55	2·93	4·71	3·03	5·19	0·93	5·02	3·85	2·53	3·88	2·20	1·33	39·15
1868	5·52	2·82	3·63	3·04	2·61	0·93	1·64	6·39	6·90	3·72	4·58	9·81	51·59
1869	8·42	2·34	2·56	2·00	4·67	0·32	1·22	1·22	5·98	0·84	2·23	5·41	37·40
1870	4·75	3·36	2·99	0·82	3·50	1·39	0·47	2·17	2·36	5·74	3·78	2·42	33·55
1871	4·81	3·93	2·18	4·51	0·71	3·74	5·09	3·57	2·60	5·31	4·39	3·90	44·67

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

MONTHLY RAINFALLS—*continued.*

Killaloe, County Clare.

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The Year.
1862	6·17	1·36	4·61	5·33	4·07	2·99	4·54	2·42	1·98	8·07	2·96	5·35	49·85
1863	5·40	2·90	3·95	2·86	2·91	3·25	0·86	5·60	6·23	6·27	7·27	4·62	52·12
1864	2·95	1·88	2·85	1·22	1·84	3·39	1·64	1·63	5·68	3·23	6·48	2·90	35·64
1865	6·13	5·16	3·42	0·45	5·52	2·19	3·54	4·34	1·10	5·05	5·06	4·08	46·04
1866	6·63	5·51	3·85	2·05	3·05	4·48	1·96	4·55	6·47	2·44	4·77	6·02	51·78
1867	3·82	5·21	3·06	6·43	3·45	2·34	3·62	4·70	3·14	7·63	1·57	1·90	46·87
1868	3·93	4·41	5·12	3·22	3·08	1·97	1·41	5·80	2·98	6·20	2·35	6·67	47·14
1869	5·01	5·96	3·86	3·89	4·20	1·45	2·80	1·02	8·87	1·52	5·49	6·50	50·57
1870	5·75	3·02	2·74	2·07	3·93	0 71	1·30	2·49	3·66	9·91	2·20	3·00	40·78
1871	4·96	3·70	2·52	4·92	0·99	2·75	5·99	2·81	2·02	4·50	2·00	3·54	40·70

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

Fassaroe, Bray, County Wicklow.

1862	6·54	3·26	4·34	3·49	2·76	4·01	3·23	2·53	3·	4·39	2·91	5·33	45·80
1863	6·14	0·58	3·31	0·74	1·26	2·05	1·40	3·20	2·26	8·07	2·74	4·12	35·87
1864	3·09	1·22	4·12	0·46	1·38	1·63	0·41	1·38	2·01	7·24	5·62	3·10	31·66
1865	4·03	4·29	1·88	1·85	4·82	0·79	4·42	4·46	0·09	5·38	6·00	4·25	42·21
1866	4·28	3·23	4·99	3·40	0·96	5·31	0·91	2·50	4·22	4·18	1·78	2·45	38·21
1867	4·35	3·12	6·58	2·65	5 17	0·80	3·03	1·11	2·29	3·13	0·63	2·42	35·28
1868	4·09	1·90	3·18	2·62	1·42	1·43	1·00	6·55	4·98	1·85	3·65	9·09	41·71
1869	6·53	2·19	3·69	1·75	8·22	1·25	0·72	0·76	4·76	2·44	2·49	4·16	38·96
1870	4·20	3·36	3·15	0·65	2·27	0·48	0·46	2·20	2·64	8·64	2·19	2·90	33·14
1871	3·79	3·98	1·72	3·47	0·32	3·08	4·11	1·24	4·46	3·48	1·81	1·79	33·25

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

Blackrock, County Dublin.

1862	2·38	0·91	2·59	2·40	2·19	2·29	2·40	1·94	1·50	1·95	1·49	1·94	24·98
1863	1·64	0·36	1·38	0·92	0·56	1·82	0·72	2·25	3·29	5·41	1·59	3·13	23·07
1864	1·83	0·89	3·03	0·58	1·78	1·26	0·59	1·47	1·65	6·44	4·01	2·20	25·73
1865	3·18	2·19	1·21	1·61	2·89	0·47	2·71	4·32	0·02	4·15	3·78	3·29	29 80
1866	2·41	2·13	4·27	2·06	1·48	4·06	0·80	1·92	2·89	2·64	1·28	1·60	27·54
1867	3·07	2·26	4·47	2·55	3·55	0·57	3·22	1·09	1·70	2·23	0·30	1·05	26·11
1868	3·99	1·82	2·19	2·08	1·19	1·02	0·77	5·17	3·52	1·00	3·19	6·73	32·67
1869	5·24	1·09	1·83	1·10	7·08	1·08	0·43	0·86	4·08	1·18	2·21	3·56	29·69
1870	2·59	2·68	2·12	0·65	1·20	0·70	0·68	1·96	1·32	6·64	1·54	2·94	25·02
1871	3·16	2·63	0·68	2·86	0·16	2·54	5·94	1·10	4·10	2·84	1·11	0·99	28·11

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872

MONTHLY RAINFALLS—*continued.*

CORK.

YEARS.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	THE YEAR.
1862	6·72	2·49	4·27	3·01	3·65	3·91	3·91	2·57	3·07	5·22	3·38	5·07	47·27
1863	3·41	1·32	4·70	2·01	1·53	3·89	1·48	4·77	1·80	7·24	3·96	4·07	40·18
1864	4·07	1·67	3·24	1·77	2·44	2·06	0·70	1·87	2·77	4·81	5·78	3·43	34·61
1865	4·22	3·00	3·82	1·54	4·36	0·66	3·35	4·39	0·85	3·29	6·84	6·69	43·01
1866	6·76	2·76	3·97	2·70	2·12	3·74	0·44	3·61	4·43	3·21	4·10	4·22	42·06
1867	5·12	2·59	8·03	3·30	5·37	1·57	2·93	2·29	3·58	4·66	1·75	1·50	42·69
1868	6·82	2·16	3·28	2·97	2·35	0·95	1·20	5·92	5·98	2·87	5·83	9·99	50·32
1869	8·59	2·96	2·85	2·58	5·48	0·18	2·07	0·87	5·15	0·67	2·44	7·12	40·96
1870	4·76	4·39	2·24	1·14	2·38	0·64	1·01	1·60	3·44	6·70	3·33	3·98	35·61
1871	4·92	4·47	2·64	4·48	0·65	4·22	4·67	2·05	4·59	3·43	5·06	4·20	45·38

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

VALENTIA, COUNTY KERRY.

1862	8·22	2·11	4·86	5·14	4·15	4·70	3·06	3·57	3·33	10·03	6·02	7·00	62·16
1863	5·32	3·30	8·23	3·27	2·15	3·67	1·26	7·67	5·94	8·56	8·76	6·51	64·64
1864	5·44	2·89	3·96	1·55	2·51	4·92	1·44	3·44	5·32	2·72	8·04	5·39	47·62
1865	8·02	3·71	4·19	1·71	3·54	1·31	2·35	6·17	4·11	8·60	9·08	6·30	59·09
1866	7·64	4·39	5·07	3·52	2·28	3·30	2·47	5·57	5·79	4·02	4·26	5·81	54·12
1867	5·62	4·87	3·45	4·97	3·07	2·05	3·58	4·67	5·86	8·84	1·47	4·14	52·39
1868	6·59	4·78	5·91	3·34	3·53	1·66	3·35	3·46	2·83	5·89	6·72	10·11	58·17
1869	9·56	4·53	3·54	4·12	2·76	1·06	3·81	1·89	8·05	2·64	4·19	8·37	54·55
1870	6·16	4·60	1·94	3·61	4·50	0·61	2·05	2·62	4·25	10·03	4·97	2·59	47·93
1871	5·60	4·67	5·93	5·06	1·72	5·00	5·57	2·74	2·58	7·20	4·33	5·45	55·85

The first eight years are taken from the British Association Reports for 1864, 1866, 1868, and 1870; the two last from the telegraphic reports supplied by observer.

GALWAY, QUEEN'S COLLEGE.

1862	7·31	2·36	3·94	4·02	3·34	2·72	4·20	3·54	2·68	6·68	2·20	8·62	51·61
1863	8·52	5·02	4·44	4·22	5·25	5·18	0·41	5·36	7·03	4·90	8·01	4·18	62·52
1864	4·62	4·16	5·33	2·99	2·88	5·41	3·01	4·10	7·32	4·88	9·23	4·14	58·07
1865	9·01	5·04	2·54	0·74	4·19	1·26	4·60	4·91	2·21	5·91	3·97	4·52	48·90
1866	8·96	4·64	3·29	2·22	1·97	4·28	1·94	5·11	6·96	2·60	4·02	5·60	51·59
1867	4·77	4·98	2·37	4·13	4·67	1·75	3·15	4·49	3·52	5·29	0·74	2·23	43·09
1868	5·29	5·25	5·38	2·28	3·74	1·74	2·51	3·93	2·41	6·16	2·63	6·49	47·81
1869	4·27	6·12	3·44	2·41	4·80	1·60	3·87	1·47	8·46	1·67	5·01	8·07	52·19
1870	4·11	2·72	1·45	2·61	4·36	1·45	3·43	3·29	3·51	9·69	4·57	3·65	44·84
1871	6·44	4·78	2·21	3·44	1·28	3·50	6·20	3·64	2·18	2·20	1·38	2·44	39·69

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

MONTHLY RAINFALLS—*continued.*

Florence Court, County Fermanagh.

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The Year.
1862	7·34	1·39	5·45	3·43	2·79	4·03	5·04	2·50	2·21	5·71	3·12	6·37	49·38
1863	5·24	2·72	3·02	1·62	2·70	3·70	0·79	4·60	4·54	4·69	4·32	4·51	42·45
1864	2·69	1·59	3·17	2·07	1·80	3·04	0·84	2·37	2·36	1·30	5·99	2·21	29·43
1865	4·09	4·38	3·18	1·10	3·67	0·61	3·05	5·11	0·99	5·85	5·19	5·93	43·15
1866	10·05	2·46	3·66	2·34	0·65	1·87	1·81	6·15	5·28	4·47	6·34	5·57	50·65
1867	5·40	3·65	4·55	5·68	3·84	0·67	5·89	3·49	3·87	6·15	1·08	2·69	46·96
1868	7·30	3·47	5·27	1·78	2·69	2·37	0·49	3·62	1·78	5·82	5·77	8·81	49·17
1869	5·66	6·26	2·75	2·80	2·97	0·68	2·58	1·29	4·35	1·95	6·11	7·08	44·48
1870	4·86	5·38	1·44	2·01	3·62	1·13	0·27	1·38	3·74	12·15	2·64	4·35	42·97
1871	4·49	4·75	3·93	4·56	1·17	1·91	8·22	3·37	2·19	3·57	4·24	3·89	46·29

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

Doo Castle, County Sligo.

1864	3·04	1·80	2·97	1·90	2·04	2·84	1·60	2·32	4·42	2·19	5·23	1·54	31·81
1865	4·65	2·86	3·28	1·40	2·55	1·33	3·99	3·85	0·61	5·61	4·98	4·51	39·62
1866	6·55	3·88	2·93	1·65	1·71	4·61	2·04	5·39	5·20	2·40	4·25	4·60	45·21
1867	4·40	4·42	2·70	4·86	4·62	1·63	4·63	2·78	3·07	7·27	0·72	2·97	44·07
1868	5·11	3·69	4·24	1·49	3·23	1·81	1·55	3·80	3·05	4·11	4·58	7·81	44·47
1869	4·68	5·21	3·43	3·34	2·72	1·11	2·23	1·34	4·07	2·34	6·18	6·19	42·84
1870	3·31	4·12	2·23	1·72	3·30	1·53	1·66	0·86	3·59	9·92	2·56	3·41	38·21
1871	4·57	3·86	3·06	4·18	1·42	3·65	5·64	2·41	2·21	3·67	2·57	3·60	40·84
1872	6·44	3·60	4·70	1·16	2·43	2·96	3·15	4·28	6·96	6·33	5·82	5·03	52·86
1873	5·01	1·02	2·83	1·29	2·45	1·89	4·23	5·35	2·42	4·81	1·86	1·63	34·29

The first eight years are copied from the British Association Reports for 1866, 1868, 1870, and 1872; the last two from Symons's Meteorological Magazine.

Belturbet, Red Hills, County Cavan.

1864	1·68	1·53	2·34	2·29	1·80	2·94	1·53	1·96	4·19	1·56	5·19	2·06	29·07
1865	3·28	4·62	2·84	0·78	4·05	0·48	2·91	3·93	0·66	5·92	4·12	3·33	36·92
1866	5·16	2·92	3·28	2·97	1·54	2·72	2·18	3·34	4·41	2·64	3·66	4·28	39·10
1867	4·15	2·38	2·37	5·59	3·59	1·26	4·54	2·72	2·86	5·49	1·15	1·95	38·05
1868	4·11	3·19	3·58	2·38	2·52	3·01	0·96	4·26	1·88	2·79	2·94	5·10	36·72
1869	3·01	4·23	2·88	2·67	2·88	1·06	1·65	1·46	3·32	1·38	3·78	3·60	31·92
1870	4·19	2·51	1·54	1·16	2·91	1·22	1·65	1·24	3·35	7·60	1·86	3·22	22·45
1871	4·33	3·36	2·83	3·31	0·92	2·09	7·82	2·46	2·03	2·59	1·78	2·52	36·04
1872	–	–	–	–	–	–	–	–	–	–	–	–	43·07
1873	–	–	–	–	–	–	–	–	–	–	–	–	31·61

The first eight years are copied from the British Association Reports for 1866, 1868, 1870, and 1872; the last two from Symons's "British Rainfall."

MONTHLY RAINFALLS—*continued.*

WARINGSTOWN, COUNTY DOWN.

YEARS.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	THE YEAR.
1862	–	–	–	–	–	–	–	–	–	3·65	2·71	–	34·45
1863	2·68	0·76	1·53	1·55	2·08	2·36	0·52	3·66	3·00	5·74	2·55	1·96	28·39
1864	1·65	1·19	2·11	2·05	2·12	2·64	1·15	2·28	2·21	1·98	3·93	2·13	25·44
1865	2·95	2·75	2·25	0·59	3·80	0·53	1·28	3·16	0·88	4·91	3·65	2·36	28·62
1866	3·94	2·53	3·08	0·98	1·27	2·57	2·94	2·90	3·48	2·06	2·85	3·36	32·00
1867	4·50	2·02	1·95	4·16	2·93	0·87	6·04	2·72	1·45	4·15	1·09	1·98	33·86
1868	2·81	2·49	3·06	2·19	2·34	0·89	0·68	4·45	1·68	2·13	2·57	4·55	29·84
1869	3·23	4·30	1·83	2·42	2·25	1·13	1·56	1·88	3·57	1·46	3·41	3·37	30·41
1870	3·15	2·15	1·27	1·62	2·18	0·95	1·87	1·45	2·74	6·81	1·77	2·42	28·38
1871	3·10	2·95	1·63	2·76	0·48	2·64	5·07	2·47	3·36	2·28	1·74	–	–

The first two years are taken from the British Association Report for 1868; the remaining years from Symons's Monthly Meteorological Magazine.

PARSONSTOWN, KING'S COUNTY.

1862	3·58	2·26	3·74	2·81	3·86	2·73	3·76	2·92	1·51	4·86	1·95	2·20	36·38
1863	3·12	1·65	2·53	1·25	1·01	0·90	0·33	3·77	3·67	4·21	4·07	2·30	28·81
1864	1·81	0·68	2·64	1·17	1·65	3·25	0·81	1·73	3·34	3·75	4·07	2·14	27·04
1865	3·88	2·71	1·80	1·05	3·69	0·85	3·19	2·82	0·48	4·03	4·21	3·19	31·90
1866	4·14	2·59	2·43	1·79	1·14	2·57	0·91	3·78	4·59	2·17	2·85	3·54	32·50
1867	1·70	2·35	1·92	3·30	2·99	1·02	3·82	2·69	1·33	4·61	1·27	1·11	28·11
1868	3·17	2·45	3·12	2·20	2·17	1·55	2·44	4·90	2·82	2·29	2·31	4·21	33·63
1869	4·06	2·57	1·78	2·88	3·72	1·51	2·15	2·07	6·15	0·62	2·92	5·13	35·56
1870	2·95	1·68	2·14	0·94	2·21	0·78	1·64	1·63	3·51	7·28	1·38	1·83	27·97
1871	2·86	2·10	2·03	2·09	2·03	2·88	5·22	2·20	0·64	3·50	1·70	2·40	29·65

The first eight years are extracted from the British Association Reports for 1864, 1866, 1868, and 1870; the last two from a letter received at this Office.

PORTARLINGTON, QUEEN'S COUNTY.

1862	5·41	1·07	2·51	3·87	4·92	3·58	3·92	3·81	2·91	5·54	2·95	4·66	45·15
1863	4·11	1·36	3·90	1·96	2·89	8·65	0·70	5·64	3·87	7·92	4·83	3·48	45·31
1864	3·97	1·15	3·74	2·08	3·18	2·12	0·79	2·50	6·23	5·87	6·31	4·51	42·45
1865	4·51	5·41	3·43	1·02	4·80	1·06	5·48	5·09	0·59	5·83	3·24	2·78	43·84
1866	3·72	3·00	2·92	1·64	1·19	3·73	1·22	2·63	4·16	1·73	1·89	2·91	30·74
1867	2·32	2·98	3·02	2·88	3·56	0·85	2·65	2·79	1·69	3·51	0·86	1·90	29·09
1868	2·25	2·27	2·71	2·14	1·78	2·32	1·10	4·09	2·89	2·08	1·67	5·10	30·40
1869	4·53	2·24	2·09	1·82	3·14	0·83	1·57	1·22	3·88	2·68	2·66	3·39	30·05
1870	2·88	1·75	2·28	0·93	2·15	0·86	1·17	1·61	2·95	6·54	1·04	1·93	26·04
1871	3·43	2·00	1·46	3·17	0·63	2·33	5·62	1·97	1·60	2·83	1·65	1·82	28·51

Extracted from British Association Reports for 1864, 1866, 1868, 1870, and 1872.

We cannot find any record in Ireland for some years of a heavier rainfall than 2½ inches in twenty-four hours. Our average rainfall is over that of England, the London average being 24½ inches per annum for the 60 years from 1813 to 1872. The rain gauge will show a very great variation in the same locality, when placed on different heights, even to the extent of 6 inches in a year, for a difference of 50 feet in level.

In estimating, therefore, the average amount of rain likely to fall annually on the roof of any building in this country, and allowing a margin for the high level of the roof, we are disposed to assume in our calculation 30 inches as the average annual rainfall. Every inch of rainfall delivers about 4⅔ gallons of water on each square yard of *level* surface, and therefore our assumed average rainfall of 30 inches per annum gives the result of 140 gallons per annum discharged on each square yard of level surface. When, therefore, the LEVEL area of the house roof-plan (not the area of the sloping roof surface, which would clearly give a much higher result) is ascertained in square yards, and multiplied by 140, the product will be the average number of gallons of rain-water that will fall on the roof in the course of one year with the rainfall 30 inches—and this amount may be expected in any part of Ireland.

If we suppose a mansion, therefore, whose level roof-plan area contains 300 square yards, we find that it will probably receive 42,000 gallons of rain-water per annum; on some very wet days receiving as much as 3,000 gallons, but averaging every day, wet and dry, about 115 gallons per day.

In making the necessary investigation and inquiries, we have received kind assistance from many observers in all parts of the United Kingdom; and we are especially indebted to R. H. Scott, Esq., F.R.S., Director of the Meteorological Office, London, who supplied some valuable monthly returns; and also to W. H. Mayne, Esq., Killaloe; R. Caulfield, Esq., LL.D., Cork; Launcelot Turtle, Esq., Lurgan; and we have to acknowledge that but for the valuable series of observations published by Mr. Symons in his successive yearly volumes of the "British Rainfall," our tables would not have been nearly so complete as they now are.

The English and Scotch average falls we give for comparison with Irish tables, as follow:—London, 24·5, average of 60 years, 1813–72; Falmouth, 40·58, 20 years, 1837–56; Stonyhurst, 46·02, 24 years, 1847–70; Haverfordwest, 47·24, 10 years, 1862–71; Barnstable, 37·91, 10 years, 1862–71; Portsmouth, 24·77, 5 years, 1866–70; Plymouth, 38·95, 5 years, 1866–70; Penzance, 41·45, 5 years, 1866-70; Yarmouth, 29·81, 5 years, 1866–70; Alnwick Castle, 28·56, 8 years, 1862–69; Scarboro', 27·67, 5 years, 1866–70; North Shields, 25·26, 10 years, 1862–71; Holyhead, 34·86, 7 years, 1866–72; Rugby, 24·24, 6 years, 1862–67; Liverpool, 26·62, 4 years, 1868–71; Kew, 22·90, 13 years, 1859–71; Glasgow, 42·83, 12 years, 1860–71; Leith, 19·83, 5 years, 1866–70; Ardrossan, 40·12, 5 years, 1866–70; Aberdeen, 28·42, 10 years, 1862–71; Nairn, 23·91, 5 years, 1860–70; Wick, 24·12, 8 years, 1862–69; Thurso, 30·41, 7 years, 1863–69; Jersey, 31·06, 8 years, 1862–69; Guernsey, 36·57, 8 years, 1862–69.

METEOROLOGICAL JOURNAL,

KEPT AT

The Royal Dublin Society's Botanic Garden, Glasnevin,

FROM

1st JANUARY to 31st DECEMBER, 1876.

JANUARY, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Saturday, .	30·012	45	30·053	43·8	40·4	44·2	33·9	40·6	42·8	81·6	29·0	S.W.	·000	Breezy, showery, bright sun.
2 Sunday, .	29·702	46	29·739	45·0	43·9	45·8	28·0	38·0	40·0	82·0	25·4	S.E.	·020	Breezy, showery, changeable.
3 Monday, .	29·970	57	29·999	55·6	53·0	56·2	44·2	43·0	43·9	106·2	40·6	S.W.	·000	Fine, breezy, bright sun.
4 Tuesday, .	30·132	54	30·147	53·0	49·0	53·8	46·0	43·0	43·8	88·6	38·0	S.E.	·000	Do.
5 Wednesday, .	30·200	50	30·225	49·9	47·4	50·0	38·9	42·2	43·6	80·0	32·4	N.E.	·010	Do.
6 Thursday, .	30·340	48	30·365	46·2	44·8	47·0	40·8	41·0	42·4	77·6	35·6	S.E.	·040	Cloudy, light showers, changeable.
7 Friday, .	30·388	40	30·442	38·0	35·0	39·0	35·0	38·4	41·0	72·0	31·2	N.E.	·000	Breezy, cold, showery, occasional sun.
8 Saturday, .	29·994	35	30·084	35·0	32·6	35·0	35·0	37·0	39·6	50·0	33·4	N.E.	·000	Breezy, cloudy, hail showers.
9 Sunday, .	30·250	35	30·320	35·2	32·0	35·0	24·0	35·0	38·2	76·0	21·0	N.W.	·000	Fine, bright sun, sharp frost.
10 Monday, .	30·400	38	30·459	35·8	34·6	37·0	27·0	33·6	36·4	72·0	23·0	N.E.	·000	Breezy, cloudy, snow showers.
11 Tuesday, .	30·302	40	30·356	39·2	36·0	39·8	31·8	34·0	36·2	73·6	39·2	N.W.	·040	Fine, bright sun, changeable.
12 Wednesday, .	30·132	46	30·168	44·4	41·8	45·0	29·2	35·2	36·8	82·0	25·0	N.W.	·000	Fine, breezy, light showers, bright sun.
13 Thursday, .	30·398	43	30·437	41·4	39·2	42·0	32·0	34·4	36·2	89·2	27·9	N.E.	·000	Breezy, cloudy, changeable.
14 Friday, .	30·556	43	30·604	41·6	40·0	42·2	48·0	34·0	35·0	79·0	22·8	N.E.	·000	Breezy, bright sun, sharp frost.
15 Saturday, .	30·568	42	30·616	41·0	40·6	41·8	31·0	34·0	35·6	82·4	29·0	S.W.	·000	Breezy, cloudy, occasional sun.
16 Sunday, .	30·390	45	30·431	43·9	42·2	44·0	33·8	35·0	36·0	77·0	27·4	S.W.	·020	Breezy, cloudy, light showers.
17 Monday, .	30·128	49	30·159	48·8	48·0	49·0	34·6	36·4	37·2	58·4	30·4	S.W.	·040	Do.
18 Tuesday, .	30·124	48	30·155	46·9	44·0	47·4	41·0	39·0	41·0	72·4	35·8	S.W.	·000	Breezy, cloudy, occasional sun.
19 Wednesday, .	29·848	54	29·864	52·2	49·4	53·0	43·0	40·0	41·2	64·8	36·5	S.W.	·010	Breezy, cloudy, light showers.
20 Thursday, .	29·612	47	29·643	45·8	42·8	46·0	45·0	41·2	42·0	60·0	41·4	S.W.	·000	Do.
21 Friday, .	29·856	42	29·905	40·4	37·0	41·0	32·6	38·0	40·0	72·6	27·5	S.W.	·000	Breezy, cloudy, occasional sun.
22 Saturday, .	30·170	41	30·224	39·0	35·2	40·6	25·0	34·2	36·8	78·2	19·8	S.W.	·000	Breezy, cloudy, sharp frost, occasional sun.
23 Sunday, .	30·108	50	30·133	48·8	45·4	49·2	38·0	38·0	39·2	57·2	34·0	S.W.	·000	Breezy, cloudy, occasional sun.
24 Monday, .	30·372	54	30·387	53·0	48·9	53·6	47·0	41·0	41·8	75·4	41·6	S.W.	·000	Fine, breezy, bright sun.
25 Tuesday, .	30·228	54	30·240	53·0	48·0	53·8	43·2	41·0	42·0	80·6	33·0	S.W.	·000	Do.
26 Wednesday, .	30·112	56	30·120	55·6	51·0	55·9	43·8	41·4	42·4	86·4	33·2	S.W.	·000	Do.
27 Thursday, .	30·090	54	30·105	52·0	49·6	53·0	46·0	42·8	43·0	90·0	35·0	S.W.	·000	Breezy, cloudy, occasional sun.
28 Friday, .	30·130	52	30·150	57·2	49·8	51·6	45·0	42·2	43·0	92·4	34·2	S.W.	·000	Do.
29 Saturday, .	30·108	51	30·133	50·0	48·0	50·8	44·6	42·0	43·0	65·2	34·6	S.E.	·060	Do.
30 Sunday, .	30·024	58	30·027	57·2	53·9	57·6	48·0	44·0	44·6	89·0	40·6	S.W.	·100	Fine, mild, bright sun.
31 Monday, .	30·096	54	30·101	53·2	50·0	53·8	49·4	44·0	45·6	100·6	41·2	S.W.	·000	Breezy, cloudy, occasional sun.
													·310	

FEBRUARY, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Tuesday, .	29·822	53	29·843	51·8	49·0	52·9	48·9	44·6	45·2	65·8	44·6	S. E.	·060	Breezy, cloudy, occasional sun.
2 Wednesday, .	30·060	48	30·091	47·2	43·0	47·9	36·6	41·0	43·4	84·0	30·0	S. W.	·000	Breezy, showery, occasional sun.
3 Thursday, .	30·054	47	30·090	45·8	42·0	46·2	42·0	40·4	42·2	86·2	36·4	S. W.	·020	Fine, breezy, occasional sun.
4 Friday, .	30·132	47	30·168	45·9	43·2	46·0	35·9	39·4	41·6	91·0	30·4	S. W.	·000	Breezy, showery, bright sun.
5 Saturday, .	30·130	45	30·171	43·6	40·4	44·0	30·6	37·2	40·0	88·2	26·0	N. W.	·000	Breezy, cold, occasional sun.
6 Sunday, .	30·110	43	30·159	41·4	37·6	42·0	28·0	35·4	38·0	87·6	21·9	N. E.	·000	Breezy, cloudy, bright sun.
7 Monday, .	30·072	42	30·121	41·2	37·4	41·2	30·4	35·8	37·2	84·2	24·0	N. E.	·000	Do.
8 Tuesday, .	30·012	39	30·071	38·1	36·6	38·6	35·8	35·4	37·0	66·4	30·6	N. E.	·000	Cloudy, snow showers.
9 Wednesday, .	29·850	40	29·905	38·6	36·9	39·0	33·9	35·0	36·8	67·0	30·2	S. W.	·300	Cloudy, cold, changeable.
10 Thursday, .	29·790	40	29·845	38·8	38·0	39·2	34·0	35·0	36·8	56·0	32·0	S. E.	·250	Breezy, showery, cold, changeable.
11 Friday, .	29·824	44	29·868	43·0	38·6	43·6	35·2	35·8	38·0	78·4	29·8	S. E.	·000	Fine, breezy, bright sun.
12 Saturday, .	29·780	44	29·824	42·8	40·0	43·0	23·2	33·4	36·2	75·0	19·4	S. E.	·270	Breezy, sharp frost, occasional sun.
13 Sunday, .	29·426	38	29·486	36·9	36·0	37·2	35·2	34·4	36·0	67·4	33·4	S. E.	·400	Breezy, cold, light showers, changeable.
14 Monday, .	29·454	46	29·492	43·8	42·0	45·0	34·0	35·2	37·0	84·2	30·6	S. E.	·230	Breezy, cloudy, occasional sun.
15 Tuesday, .	29·240	56	29·251	55·0	50·8	55·8	40·0	39·0	40·2	97·2	37·4	S. W.	·100	Fine, breezy, heavy showers, bright sun.
16 Wednesday, .	29·492	50	29·519	49·0	45·2	49·8	41·6	39·0	40·4	104·0	36·8	S. W.	·150	Do.
17 Thursday, .	29·454	49	29·481	47·4	47·0	48·0	42·0	39·4	40·2	99·0	35·4	S. W.	·060	Breezy, light showers, changeable.
18 Friday, .	29·136	55	29·152	54·0	48·8	54·8	48·2	43·0	43·6	104·2	44·6	S. W.	·000	Stormy, light showers, bright sun.
19 Saturday, .	29·378	48	29·405	47·4	41·2	47·9	38·2	41·2	43·4	105·0	38·2	S. W.	·000	Fine, breezy, bright sun.
20 Sunday, .	29·572	45	29·614	43·2	41·8	44·0	28·9	38·0	40·4	110·0	28·9	S. E.	·220	Breezy, cloudy, showery.
21 Monday, .	29·444	56	29·455	55·0	53·2	55·8	41·2	41·0	42·0	77·6	37·0	S. W.	·150	Breezy, light showers, occasional sun.
22 Tuesday, .	29·594	55	29·605	54·0	49·0	54·6	44·2	42·0	43·4	115·0	36·8	S. W.	·200	Do.
23 Wednesday, .	29·772	45	29·809	43·9	41·6	44·2	40·0	41·4	42·6	112·0	39·0	S. W.	·000	Breezy, heavy showers, occasional sun
24 Thursday, .	30·064	46	30·100	45·2	40·6	45·8	32·8	38·0	40·6	97·0	28·6	S. W.	·190	Fine, breezy, bright sun.
25 Friday, .	29·454	52	29·476	51·0	49·0	51·4	39·2	40·0	42·0	75·0	36·6	S. W.	·030	Breezy, showery, changeable.
26 Saturday, .	29·200	52	29·222	52·0	48·9	52·2	43·9	42·0	42·8	104·0	38·6	S. W.	·340	Breezy, heavy showers, bright sun.
27 Sunday, .	29·314	52	29·341	50·0	47·0	51·0	43·6	42·0	43·6	106·0	38·0	S. W.	·060	Breezy, showery, occasional sun.
28 Monday, .	29·712	54	29·728	53·0	51·8	53·6	42·9	42·4	43·4	96·4	37·8	S. W.	·140	Cloudy, mild, occasional sun.
29 Tuesday, .	29·656	55	29·672	53·4	48·0	54·0	47·6	44·0	45·0	111·0	43·8	S. W.	·000	Breezy, showery, bright sun.
													3·170	

MARCH, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Wednesday, .	29·398	55	29·415	53·8	47·4	54·2	44·0	43·4	45·0	111·6	37·4	S. W.	·030	Fine, breezy, bright sun.
2 Thursday, .	29·662	49	29·688	48·9	44·8	49·0	38·2	41·0	44·0	118·0	34·0	S. W.	·210	Breezy, hail showers, occasional sun.
3 Friday, .	29·278	60	29·298	58·2	53·0	59·6	45·4	45·0	45·4	102·0	42·6	S. W.	·030	Stormy, showery, occasional sun.
4 Saturday, .	29·534	45	29·376	44·6	44·0	44·8	38·4	40·6	43·2	100·0	34·0	S. W.	·090	Do.
5 Sunday, .	29·578	53	29·600	51·9	50·4	52·0	38·4	41·0	43·0	83·0	34·0	S. W.	·430	Breezy, heavy showers, changeable.
6 Monday, .	29·592	48	29·614	46·0	42·0	47·1	41·0	42·0	44·0	105·0	37·6	S. W.	·040	Breezy, showery, occasional sun.
7 Tuesday, .	29·766	44	29·810	42·8	39·8	43·2	33·8	38·6	41·6	99·6	31·2	S. W.	·070	Breezy, snow showers, occasional sun.
8 Wednesday, .	28·992	52	30·007	50·8	49·0	51·0	38·9	40·0	42·0	82·0	34·2	S. W.	·320	Breezy, showery, occasional sun. [sun.
9 Thursday, .	28·556	41	28·598	40·0	36·8	40·6	30·0	37·2	40·4	104·2	27·6	S. W.	·000	Stormy, heavy snow showers, occasional
10 Friday, .	28·680	49	28·700	48·2	44·6	48·9	31·0	37·0	39·4	107·0	26·4	S. W.	·020	Breezy, very cold, bright sun.
11 Saturday, .	29·150	48	29·177	46·0	40·6	47·2	34·0	37·0	39·2	105·2	30·4	N. W.	·000	Do.
12 Sunday, .	29·156	48	29·183	46·0	41·8	47·0	30·2	37·4	39·2	112·2	37·2	N. W.	·050	Fine, breezy, very cold, bright sun.
13 Monday, .	29·512	44	29·563	43·0	40·0	43·8	29·4	36·0	38·2	96·4	25·4	N. W.	·020	Breezy, hail showers, occasional sun.
14 Tuesday, .	29·392	51	29·419	50·0	40·0	50·4	41·0	39·2	40·4	77·0	38·9	S. W.	·170	Stormy, showery, changeable.
15 Wednesday, .	29·210	44	29·254	44·2	40·2	44·6	35·4	38·0	40·4	103·0	31·8	S. W.	·050	Do.
16 Thursday, .	29·614	42	29·663	42·6	37·4	42·8	32·9	36·2	39·0	89·0	29·2	N. W.	·000	Breezy, hail showers, occasional sun.
17 Friday, .	29·832	39	29·887	38·0	34·6	38·6	29·6	34·8	37·6	110·0	26·0	N. W.	·000	Breezy, very cold, sharp frost, occasional
18 Saturday, .	30·118	42	30·167	40·8	37·2	41·0	30·0	34·0	36·6	105·0	26·0	S. W.	·000	Do. [sun.
19 Sunday, .	30·220	39	30·274	38·0	34·6	38·6	27·0	33·4	36·2	97·0	23·2	N. W.	·000	Breezy, cold, snow showers. [sun.
20 Monday, .	30·146	43	30·195	41·2	37·6	42·6	30·0	33·6	36·0	92·4	25·8	N. W.	·160	Cloudy, cold, snow showers, occasional
21 Tuesday, .	29·756	39	29·811	37·0	36·4	38·0	34·2	34·0	36·2	72·6	32·0	S. E.	·060	Breezy, cold, showery, changeable. [sun.
22 Wednesday, .	30·070	42	30·191	40·9	37·6	41·2	32·4	35·0	37·0	95·4	26·8	N. E.	·000	Breezy, cold, snow showers, occasional
23 Thursday, .	29·932	48	29·963	46·4	41·0	47·0	27·6	34·9	37·0	95·0	23·8	N. W.	·000	Breezy, sharp frost, bright sun.
24 Friday, .	29·340	40	29·395	44·0	42·8	40·8	40·2	36·8	38·2	86·0	37·2	N. W.	·100	Cloudy, showery, changeable.
25 Saturday, .	29·760	50	29·786	49·8	44·2	50·0	38·2	38·0	39·8	104·2	31·8	N. E.	·000	Fine, breezy, bright sun.
26 Sunday, .	29·574	45	29·616	44·0	39·8	44·6	38·0	38·4	40·0	104·6	31·8	N. E.	·000	Do.
27 Monday, .	29·382	45	29·425	44·6	39·8	45·0	36·2	38·2	40·4	117·0	35·0	N. E.	·000	Cloudy, cold, occasional sun.
28 Tuesday, .	29·170	43	29·220	42·8	41·0	43·0	36·0	38·0	39·6	82·0	31·4	N. E.	·090	Cloudy, cold, light showers.
29 Wednesday, .	29·232	45	29·275	43·0	42·0	44·0	41·0	38·4	40·0	59·0	34·6	S. W.	·010	Cloudy, mild, light showers.
30 Thursday, .	29·484	57	29·495	56·0	48·4	56·4	34·2	39·0	41·0	124·0	30·0	N. W.	·280	Fine, breezy, bright sun.
31 Friday, .	29·508	51	29·534	49·0	45·0	50·0	38·9	39·6	41·4	112·2	36·0	S. W.	·000	Breezy, cloudy, occasional sun.
													2·180	

APRIL, 1876.

Date.	Barometer.			Thermometer.								Wind.	Rain.	Remarks.
	Uncorrected.	Attached Thermometer.	Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers.				Earth Thermometers.		Grass Thermometers freely exposed.		Direction.	Previous 24 Hours.	
				Dry B.	Wet B.	Max.	Min.	5 Inch.	10 Inch.	Max.	Min.			
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Saturday, .	29·772	56	29·781	54·9	48·6	55·6	38·0	40·6	42·4	125·4	32·4	N.W.	·000	Fine, breezy, bright sun.
2 Sunday, .	29·932	60	29·931	58·6	50·4	59·0	30·0	41·0	42·4	116·0	28·0	N.E.	·000	Do.
3 Monday, .	30·046	61	30·043	59·0	54·0	60·0	47·9	43·8	44·9	129·0	41·0	S.W.	·040	Breezy, cloudy, occasional sun.
4 Tuesday, .	30·346	63	30·338	61·4	56·8	62·2	47·2	45·2	46·0	114·0	40·6	S.W.	·000	Breezy, light showers, occasional sun.
5 Wednesday, .	30·446	61	30·443	59·2	55·0	60·0	52·0	47·0	48·6	109·6	48·0	S.W.	·000	Breezy, cloudy, occasional sun.
6 Thursday, .	30·436	55	30·450	53·9	52·0	54·2	51·0	47·2	48·4	86·0	46·4	S.E.	·000	Breezy, cloudy, changeable.
7 Friday, .	30·386	59	30·389	57·9	53·9	58·0	45·0	47·2	48·6	102·4	41·4	S.E.	·000	Cloudy, overcast, occasional sun.
8 Saturday, .	29·910	62	29·904	60·4	55·0	61·4	43·0	47·2	48·6	118·0	38·0	S.E.	·000	Do. [sun.
9 Sunday, .	29·670	61	29·667	59·6	53·0	60·4	45·4	47·2	48·8	125·0	42·4	S.W.	·590	Fine, breezy, light showers, occasional
10 Monday, .	29·346	46	29·384	45·0	41·0	45·8	36·0	44·0	47·0	109·0	45·0	S.W.	·060	Thunder and lightning, hail and heavy
														rain, occasional sun. [occasional sun.
11 Tuesday, .	29·758	40	29·813	38·9	35·2	39·6	31·0	39·0	42·4	93·0	30·0	N.W.	·000	Breezy; cold, heavy snow showers,
12 Wednesday, .	29·984	46	30·011	44·6	39·2	45·4	29·0	37·4	41·2	117·0	27·6	N.W.	·360	Breezy, very cold, sharp frost, bright sun.
13 Thursday, .	29·842	41	29·897	40·0	37·2	40·6	25·2	36·4	40·2	111·0	22·4	N.W.	·000	Breezy, snow showers, sharp frost, bright sun.
14 Friday, .	30·226	48	30·251	45·2	40·0	46·4	30·0	37·2	40·4	119·0	27·2	N.E.	·000	Breezy, very cold, hail showers, bright
15 Saturday, .	30·320	54	30·235	52·2	45·8	53·4	33·0	39·0	44·2	113·0	30·0	S.E.	·000	Cloudy, mild, occasional sun. [sun.
16 Sunday, .	30·090	57	30·108	55·8	49·2	56·4	43·6	42·0	43·6	116·0	40·0	S.E.	·000	Fine, breezy, bright sun.
17 Monday, .	29·472	50	29·499	49·0	44·8	50·0	39·9	42·0	43·6	119·6	34·2	S.E.	·100	Breezy, cloudy, occasional sun.
18 Tuesday, .	29·048	55	29·064	53·8	50·4	54·2	43·6	43·2	45·0	124·6	41·4	S.E.	·020	Breezy, showery, occasional sun.
19 Wednesday, .	28·934	50	28·962	48·8	46·4	49·2	44·0	44·0	45·6	115·0	42·0	S.E.	·250	Cloudy, showery, changeable.
20 Thursday, .	29·086	51	29·113	48·8	46·8	50·4	43·0	43·2	45·4	77·0	42·0	N.W.	·000	Cloudy, heavy rain, changeable.
21 Friday, .	29·504	58	29·518	56·6	52·0	57·6	41·8	44·6	46·2	122·0	39·8	S.W.	·000	Fine, mild, occasional sun.
22 Saturday, .	29·980	50	30·006	48·9	45·6	49·4	40·8	44·2	46·0	115·0	38·6	N.W.	·000	Breezy, cloudy, occasional sun.
23 Sunday, .	29·862	52	29·888	50·4	48·2	51·4	40·2	44·0	46·0	89·4	40·2	S.E.	·100	Do.
24 Monday, .	29·740	60	29·739	59·0	55·2	59·8	44·8	45·2	47·0	108·0	40·4	S.W.	·310	Cloudy, mild, showery, occasional sun.
25 Tuesday, .	29·972	50	29·897	48·6	46·8	49·4	44·4	44·8	46·6	110·4	42·0	N.W.	·260	Breezy, heavy hail showers, thunder, occasional sun.
26 Wednesday, .	30·108	59	30·111	56·9	50·4	58·0	37·9	44·2	46·4	111·0	33·6	S.W.	·060	Breezy, heavy showers, bright sun.
27 Thursday, .	29·772	57	29·781	55·2	53·4	56·4	47·6	45·4	47·0	89·6	43·4	S.W.	·160	Breezy, cloudy, light showers, bright sun.
28 Friday, .	29·492	58	29·477	56·0	52·0	57·6	43·0	46·0	48·0	96·4	42·8	S.W.	·130	Fine, breezy, bright sun, changeable.
29 Saturday, .	29·492	52	29·514	51·4	48·6	51·8	42·0	45·8	47·2	118·0	37·4	S.E.	·000	Cloudy, showery, changeable.
30 Sunday, .	29·980	48	30·006	48·6	41·2	47·4	40·0	44·4	46·2	106·4	34·8	S.E.	·000	Fine, breezy, bright sun.
													2·380	

MAY, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Monday, .	30·110	50	30·145	49·2	45·4	50·2	37·2	44·8	47·4	107·6	31·0	N.E.	·010	Breezy, hail showers, bright sun.
2 Tuesday, .	30·262	55	30·276	54·0	46·4	54·8	30·2	43·2	45·2	118·4	26·8	S.E.	·000	Breezy, bright sun, sharp frost. [frost.
3 Wednesday,.	30·350	55	30·364	53·6	48·2	54·0	29·6	43·0	45·2	115·8	25·4	S.E.	·000	Breezy, cloudy, occasional sun, sharp
4 Thursday, .	30·442	60	30·439	58·0	49·6	59·2	33·8	44·2	46·4	116·4	28·2	S.E.	·000	Fine, breezy, bright sun.
5 Friday, .	30·304	60	30·301	58·4	50·2	59·6	36·0	45·2	47·4	109·6	31·0	S.E.	·000	Breezy, very cold, bright sun.
6 Saturday, .	30·318	63	30·310	61·2	51·8	62·0	34·8	46·0	47·8	114·8	30·6	S.E.	·000	Fine, breezy, bright sun.
7 Sunday, .	30·394	60	30·391	58·0	51·2	59·4	37·2	47·0	48·8	118·0	33·2	S.E.	·000	Do.
8 Monday, .	30·438	56	30·446	55·0	49·0	55·8	36·8	47·8	49·0	115·6	31·9	S.E.	·000	Do.
9 Tuesday, .	30·448	52	30·468	50·6	48·0	51·4	40·4	47·0	48·6	116·2	33·0	S.E.	·000	Breezy, cold, bright sun.
10 Wednesday,.	30·360	52	30·380	51·0	45·8	51·8	42·0	46·8	48·4	108·6	35·2	S.E.	·000	Breezy, cloudy, occasional sun.
11 Thursday, .	30·250	57	30·258	55·8	49·2	56·6	42·6	47·2	49·0	114·2	37·0	S.E.	·000	Fine, breezy, bright sun.
12 Friday, .	30·276	58	30·279	56·4	49·6	57·4	42·8	47·2	49·4	117·6	34·8	S.E.	·000	Breezy, cloudy, occasional sun.
13 Saturday, .	30·378	59	30·375	56·4	49·0	58·4	42·0	48·4	50·2	119·0	37·4	S.E.	·000	Fine, breezy, bright sun.
14 Sunday, .	30·180	61	30·177	60·0	52·4	60·6	31·8	47·0	48·6	118·6	29·2	N.E.	·240	Cloudy, mild, occasional sun.
15 Monday, .	30·188	54	30·203	52·8	46·2	53·4	42·4	48·0	49·4	122·0	36·6	N.E.	·000	Breezy, heavy showers, bright sun.
16 Tuesday, .	30·246	53	30·260	52·0	46·0	52·8	44·8	48·0	50·0	124·0	38·0	N.E.	·010	Breezy, cloudy, light showers.
17 Wednesday,.	30·282	56	30·290	55·0	49·2	55·8	43·0	48·6	50·0	119·4	37·6	N.E.	·000	Breezy, cloudy, bright sun.
18 Thursday, .	30·332	53	30·347	51·2	47·0	52·0	42·6	48·0	49·8	119·2	35·4	N.E.	·000	Breezy, cloudy, changeable.
19 Friday, .	30·420	59	30·417	58·0	51·2	58·8	35·8	47·6	49·4	123·6	31·2	N.E.	·000	Fine, breezy, bright sun.
20 Saturday, .	30·370	62	30·362	62·0	57·2	62·2	40·6	50·0	51·2	130·4	36·0	N.E.	·000	Fine, mild, bright sun.
21 Sunday, .	30·024	70	29·993	68·8	57·0	69·2	43·9	51·2	52·6	135·0	37·6	N.E.	·260	Fine, breezy, bright sun.
22 Monday, .	29·614	62	29·608	60·2	54·0	61·4	49·1	50·4	52·4	136·2	46·2	S.W.	·400	Breezy, showery, occasional sun.
23 Tuesday, .	29·654	58	29·658	57·0	52·4	57·6	44·4	49·0	52·4	126·0	48·0	S.W.	·170	Breezy, cloudy, occasional sun.
24 Wednesday,.	29·788	55	29·804	53·4	50·0	54·2	46·0	49·0	51·6	129·0	40·4	N.E.	·000	Breezy, showery, occasional sun.
25 Thursday, .	29·960	57	29·968	55·2	49·0	56·4	43·9	48·6	51·0	116·4	39·6	N.E.	·000	Breezy, cloudy, occasional sun.
26 Friday, .	29·910	60	29·907	58·8	55·0	59·6	44·0	49·0	51·0	119·0	38·8	S.W.	·000	Breezy, cloudy, changeable.
27 Saturday, .	30·080	63	30·072	61·0	55·8	62·0	53·6	51·0	52·4	136·0	51·2	S.W.	·000	Breezy, cloudy, occasional sun.
28 Sunday, .	30·284	62	30·276	61·0	54·0	61·8	49·8	51·0	52·8	127·0	47·0	S.W.	·000	Do.
29 Monday, .	30·204	62	30·196	60·9	54·8	61·4	51·0	51·0	53·0	105·0	49·8	S.W.	·000	Do.
30 Tuesday, .	30·052	61	30·049	60·0	54·4	60·8	53·6	51·6	53·6	125·0	50·6	S.W.	·000	Breezy, overcast, occasional sun.
31 Wednesday,	30·220	60	30·217	58·2	51·0	59·4	45·0	50·6	53·0	126·6	41·4	N.W.	·000	Cloudy, occasional sun, thunder.
													1·090	

JUNE, 1876.

Date.	Barometer. Uncorrected.	Attached Thermometer.	Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Wet B.	Max.	Min.	Earth Thermometers. 5 Inch.	10 Inch.	Grass Thermometers freely exposed. Max.	Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Thursday, .	30·250	71	30·219	70·6	59·9	70·8	42·0	52·0	54·0	145·2	37·8	S.W.	·000	Fine, breezy, bright sun.
2 Friday, .	30·090	65	30·077	64·4	58·4	65·0	46·2	52·2	55·0	132·4	40·0	S.E.	·020	Breezy, cloudy, occasional bright sun.
3 Saturday, .	29·544	55	29·559	53·8	53·2	54·0	48·6	53·0	54·6	119·0	42·0	S.W.	·200	Breezy, showery, changeable.
4 Sunday, .	29·796	58	29·800	56·8	51·6	57·2	44·0	50·4	53·0	99·0	40·0	S.W.	·180	Breezy, occasional sun, light showers.
5 Monday, .	29·830	60	29·829	59·0	50·8	59·8	50·0	51·0	53·4	129·0	48·2	S.W.	·000	Breezy, showery, occasional sun.
6 Tuesday, .	29·966	62	29·958	60·6	52·0	61·4	41·0	50·6	53·0	125·0	34·4	S.W.	·020	Fine, breezy, bright sun.
7 Wednesday, .	29·906	59	29·903	57·9	50·6	58·6	46·0	50·4	53·2	134·6	41·0	S.W.	·010	Breezy, light showers, occasional sun.
8 Thursday, .	29·814	56	29·823	54·0	52·6	55·2	43·6	50·0	52·0	109·0	38·2	S.W.	·480	Cloudy, light showers, changeable.
9 Friday, .	29·952	62	29·944	60·6	52·8	61·4	45·8	50·4	53·0	129·0	41·0	N.E.	·000	Breezy, heavy showers, bright sun.
10 Saturday, .	30·316	66	30·297	65·2	55·2	66·2	41·0	51·0	53·2	134·0	33·6	S.W.	·000	Fine, breezy, bright sun.
11 Sunday, .	30·184	72	30·147	70·2	63·6	71·2	49·0	53·6	55·0	141·0	41·0	S.W.	·000	Breezy, cloudy, bright sun.
12 Monday, .	30·084	66	30·063	64·8	51·0	65·4	55·9	54·8	56·2	136·2	54·0	S.W.	·000	Breezy, cloudy, occasional sun.
13 Tuesday, .	30·024	57	30·032	55·2	53·0	56·2	47·0	52·0	55·0	123·0	35·0	S.W.	·400	Do.
14 Wednesday, .	29·918	63	29·910	61·6	54·8	62·0	44·6	51·0	54·2	127·0	35·4	S.W.	·100	Breezy, heavy showers, occasional sun.
15 Thursday, .	29·746	59	29·745	58·8	55·0	59·2	47·6	51·0	53·6	133·2	43·8	S.W.	·080	Breezy, showery, bright sun.
16 Friday, .	29·854	62	29·848	60·0	52·9	61·0	41·4	50·4	53·0	131·4	34·6	S.W.	·070	Breezy, showery, occasional sun.
17 Saturday, .	29·580	63	29·574	61·0	57·2	62·0	44·8	51·2	53·6	129·0	37·0	S.W.	·000	Do.
18 Sunday, .	30·012	66	29·991	65·0	56·8	65·9	48·2	52·0	54·0	124·0	44·0	S.W.	·000	Fine, breezy, bright sun.
19 Monday, .	29·940	66	29·919	64·2	58·8	65·2	55·6	54·0	55·4	133·6	50·4	S.W.	·000	Breezy, cloudy, occasional sun.
20 Tuesday, .	29·906	77	29·858	75·8	65·6	76·4	55·2	56·4	58·2	136·0	49·2	S.W.	·000	Stormy, bright sunshine.
21 Wednesday, .	29·820	68	29·794	65·8	60·0	66·2	57·6	57·2	58·4	140·6	51·0	S.E.	·010	Breezy, cloudy, occasional sun.
22 Thursday, .	30·056	67	30·035	66·0	58·0	57·0	45·0	55·6	57·0	128·0	37·8	S.E.	·000	Fine, breezy, light showers, bright sun.
23 Friday, .	30·022	70	29·991	70·0	58·4	70·2	44·0	55·2	56·8	136·0	38·2	S.E.	·000	Fine, breezy, bright sunshine.
24 Saturday, .	29·992	65	29·977	64·0	58·9	64·6	38·4	55·2	57·4	131·4	46·4	S.E.	·000	Cloudy, heavy fog, changeable.
25 Sunday, .	30·180	69	29·950	67·2	56·2	68·0	51·0	56·4	57·6	130·6	45·0	S.E.	·000	Breezy, bright sun.
26 Monday, .	30·188	78	30·134	77·4	64·0	78·0	51·0	59·6	59·8	139·0	45·0	S.E.	·000	Fine, warm, bright sun.
27 Tuesday, .	30·266	75	30·223	74·8	65·8	75·0	51·2	59·6	60·8	139·4	45·0	S.E.	·000	Do. [sun.
28 Wednesday, .	30·244	62	30·236	61·0	55·6	61·6	51·0	57·0	60·0	137·0	44·8	N.W.	·000	Breezy, cloudy, changeable, occasional
29 Thursday, .	30·126	61	30·123	59·6	54·0	60·0	51·0	55·4	58·2	91·6	47·2	N.W.	·000	Do.
30 Friday, .	29·990	70	29·979	68·8	63·2	69·4	56·0	57·2	49·0	124·0	48·2	S.W.	·000	Fine, breezy, bright sun.
													1·570	

JULY, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Saturday, .	29·854	74	29·812	72·2	63·6	73·0	57·8	59·0	60·4	136·0	54·0	S. W.	·000	Fine, breezy, bright sun.
2 Sunday, .	30·068	73	30·031	71·4	61·2	72·0	57·4	59·8	61·0	143·0	55·4	N. W.	·000	Breezy, fine, bright sun.
3 Monday, .	30·030	78	29·976	76·4	66·8	77·2	48·0	60·8	62·0	147·6	40·0	S. E.	·000	Fine, breezy, bright sun.
4 Tuesday, .	30·040	66	30·019	64·2	57·9	65·4	54·6	58·0	60·8	146·2	49·0	S. W.	·000	Breezy, cloudy, occasional sun.
5 Wednesday, .	29·818	65	29·804	63 9	55·4	64·2	57·4	58·0	60·8	125·4	53·6	S. W.	·000	Do.
6 Thursday, .	29·980	68	29·954	66 0	57·6	67·4	47·0	58·0	60·0	135·0	39·4	S. E.	·100	Fine, breezy, bright sun.
7 Friday, .	29·688	64	29·676	62·4	60·0	63·2	54·4	58·0	60·0	132·0	52·4	S. E.	·150	Cloudy, mild, light rain.
8 Saturday, .	29·776	70	29·745	69·0	62·8	69·8	56·8	58·8	60·4	125·0	52·6	S. W.	·000	Breezy, showery, occasional sun.
9 Sunday, .	29·882	68	29·858	66·8	58·8	67·4	55·4	58·0	60·0	139·0	52·0	S. W.	·000	Breezy, cloudy, occasional sun.
10 Monday, .	29·946	63	29·938	61·4	54·4	62·6	50·4	55·4	59·0	136·2	45·8	N. W.	·010	Breezy, cloudy, light showers, occasional sun.
11 Tuesday, .	30·348	65	30·333	63·8	55·9	64·6	51·2	55·0	58·4	132·0	45·4	S. W.	·000	Breezy, cloudy, occasional sun.
12 Wednesday, .	30·428	75	30·385	73·4	61·0	74·2	44·0	57·4	59·2	138·4	38·2	S. W.	·000	Fine, breezy, bright sun.
13 Thursday, .	30·450	73	30·413	72·0	63·0	72·8	57·0	61·0	62·0	151·6	49·0	S. E.	·000	Do.
14 Friday, .	30·484	76	30·436	75·4	64·8	76·0	53·0	61·8	63·0	146·4	45·0	S. E.	·000	Do.
15 Saturday, .	30·486	78	30·432	77·2	65·8	77·6	50·0	62·4	63·8	137·0	41·0	S. E.	·000	Do.
16 Sunday, .	30·346	86	30·270	85·0	71·0	85·0	52·0	64·2	65·2	150·0	44·6	S. E.	·000	Do.
17 Monday, .	30·400	70	30·369	69·0	61·4	69·8	58·0	64·0	65·4	154·0	50·0	N. E.	·000	Breezy, cloudy, occasional sun.
18 Tuesday, .	30·320	72	30·283	70·8	61·0	71·4	46·4	61·2	64·0	151·0	38·0	S. W.	·000	Do.
19 Wednesday, .	30·318	77	30·270	76·0	65·2	76·8	59·6	63·0	64·6	143·0	53·4	S. W.	·000	Fine, breezy, bright sun.
20 Thursday, .	30·330	71	30·299	69·4	63·0	70·6	52·0	63·0	64·4	149·0	43·0	S. W.	·000	Breezy, cloudy, occasional sun.
21 Friday, .	30·194	78	30·150	76·8	65·9	77·4	57·8	65·0	66·0	150·0	48·8	S. E.	·000	Fine, breezy, bright sun.
22 Saturday, .	30·074	70	30·043	68·0	61·6	69·4	59·0	63·0	65·0	152·0	51·4	S. W.	·000	Breezy, cloudy, occasional sun.
23 Sunday, .	30·116	67	30·095	66·0	58·6	66·8	46·0	60·2	63·4	129·0	38·4	S. W.	·000	Do.
24 Monday, .	30·246	73	30·209	72·0	63·4	72·8	46·4	61·4	63·3	140·6	36·8	N. W.	·000	Fine, breezy, bright sun.
25 Tuesday, .	30·258	74	30·216	73·2	64·0	73·4	51·4	61·4	63·2	159·0	41·0	S. W.	·120	Do.
26 Wednesday, .	29·946	65	29·931	63·4	63·0	64·0	61·0	61·0	63·0	143·0	57·8	S. W.	·760	Breezy, showery, changeable.
27 Thursday, .	30·100	65	30·085	63·6	56·8	64·2	44·6	57·0	60·6	128·5	38·0	S. W.	·220	Breezy, cloudy, occasional sun.
28 Friday, .	29·568	63	29·562	61·6	55·8	62·0	54·2	57·4	60·8	136·2	48·2	S. W.	·000	Breezy, showery, occasional sun.
29 Saturday, .	29·894	68	29·870	61·8	59 0	62·0	58·0	57·2	59·2	129·4	41·9	S. W.	·000	Fine, breezy, bright sun.
30 Sunday, .	29·794	70	29·765	68·2	61·1	69·1	55·2	58·2	60·7	140·9	40·6	S. W.	·090	Fine, breezy, overcast, with outbursts of sunshine.
31 Monday, .	29·634	68	29·628	61·4	54·6	62·0	55·2	58·0	60·2	139·2	43·2	N. E.	·040	Strong breeze, overcast, light showers, occasional sun.
													1·400	

AUGUST, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Tuesday,	29·934	65	29·921	64·2	55·4	65·1	46·1	55·2	58·2	128·7	40·1	N.W.	·080	Strong breeze, very cold, light showers, bright sun.
2 Wednesday,	29·740	59	29·744	58·1	57·2	59·0	45·0	55·0	57·1	125·0	43·1	S.E.	1·050	Strong breeze, heavy rain, occasional sun.
3 Thursday,	29·430	63	29·425	60·4	56·8	59·8	56·0	55·4	57·2	122·0	52·3	S.W.	·040	Stormy, overcast, light showers, occasional sun.
4 Friday,	29·880	62	29·874	61·4	59·0	61·8	58·2	55·2	57·3	119·0	46·3	N.E.	·010	Calm and overcast, light showers,
5 Saturday,	30·160	68	30·134	66·4	59·0	65·6	50·0	56·2	57·5	131·4	41·0	W.	·010	Do. [occasional sun.
6 Sunday,	30·130	66	30·109	64·8	60·0	60·0	57·0	57·4	59·4	135·8	49·9	S.W.	·050	Breezy, overcast, light showers, occa-
7 Monday,	30·116	75	30·074	74·2	66·1	74·8	61·3	60·1	62·0	131·3	57·4	S.W.	·000	Fine, breezy, bright sun. [sional sun.
8 Tuesday,	30·134	70	30·103	69·2	62·8	70·0	60·0	60·0	61·6	138·0	53·8	S.E.	·000	Breezy, cloudy, occasional sun.
9 Wednesday,	30·022	73	29·985	71·0	62·6	72·4	59·0	61·0	62·4	131·0	49·8	S.W.	·000	Breezy, cloudy, bright sun.
10 Thursday,	30·368	70	30·337	68·8	59·0	69·4	46·0	58·0	61·2	121·0	39·9	N.W.	·000	Fine, breezy, bright sun.
11 Friday,	30·338	72	30·301	71·0	60·4	71·6	47·6	59·0	61·0	129·0	39·8	S.W.	·000	Do.
12 Saturday,	30·218	74	30·176	73·0	64·6	78·8	44·8	60·0	61·8	118·0	41·4	S.E.	·000	Do.
13 Sunday,	29·970	76	30·022	75·4	66·2	75·9	52·2	62·0	63·2	118·0	43·0	N.E.	·000	Do.
14 Monday,	29·992	77	30·044	76·0	68·0	76·8	55·6	62·0	63·6	122·4	47·6	S.E.	·000	Do.
15 Tuesday,	30·008	73	29·991	72·2	65·4	72·9	52·0	62·4	64·0	120·0	48·8	S.E.	·000	Do.
16 Wednesday,	30·040	79	29·986	79·0	68·8	79·4	53·0	63·0	64·4	117·4	48·0	S.E.	·000	Fine, very calm, bright sun.
17 Thursday,	29·934	72	29·897	71·0	64·0	71·8	57·6	63·1	64·2	120·2	49·8	S.E.	·690	Breezy, overcast, occasional sun. [ning.
18 Friday,	29·924	65	29·909	63·8	62·4	64·2	61·0	62·0	63·4	110·0	57·0	S.E.	·170	Cloudy, heavy rain, with thunder & light-
19 Saturday,	29·960	69	29·929	67·4	63·2	68·4	50·2	62·0	63·8	121·4	58·0	S.E.	·020	Breezy, showery, occasional sun.
20 Sunday,	29·904	71	29·873	70·6	62·8	70·8	56·8	62·0	63·6	123·0	50·6	S.E.	·000	Breezy, light showers, bright sun.
21 Monday,	29·954	70	29·923	68·2	63·6	69·4	55·6	61·8	63·4	120·4	47·6	S.E.	·000	Cloudy, mild, occasional sun.
22 Tuesday,	29·974	66	29·953	64·0	56·0	65·0	57·6	60·6	63·0	124·0	52·0	S.E.	·000	Fine, breezy, bright sun.
23 Wednesday,	29·948	67	29·923	65·6	52·4	60·2	41·2	57·0	60·4	127·0	33·0	S.W.	·000	Do.
24 Thursday,	29·922	62	29·817	60·0	54·0	61·0	45·0	55·0	59·0	126·4	38·0	N.W.	·020	Breezy, cloudy, occasional sun. [shine.
25 Friday,	30·136	68	30·131	61·0	59·0	62·0	39·2	64·0	67·0	123·2	52·4	N.W.	·000	Breezy, cloudy, with outbursts of sun-
26 Saturday,	29·854	61	29·856	59·0	55·6	60·2	48·0	53·2	56·2	120·0	42·0	S.W.	·000	Breezy, cloudy, changeable.
27 Sunday,	29·890	63	29·884	62·0	55·0	62·8	52·8	54·2	56·6	109·0	47·8	S.W.	·020	Fine, breezy, bright sun.
28 Monday,	29·879	67	29·860	65·8	60·0	66·4	54·0	56·8	58·0	120·0	48·0	S.W.	·000	Breezy, light showers, occasional sun.
29 Tuesday,	29·772	65	29·758	64·0	52·6	64·8	51·4	56·0	58·2	132·0	46·2	S.W.	·040	Do.
30 Wednesday,	29·370	60	29·370	58·8	56·4	59·2	51·0	55·0	57·2	121·0	42·0	S E.	·190	Do.
31 Thursday,	29·396	61	29·396	60·0	54·0	60·8	44·0	53·0	55·6	121·0	38·6	S.W.	·000	Stormy, showery, occasional sun.
													2·390	

JULY, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Saturday,	29·854	74	29·812	72·2	63·6	73·0	57·8	59·0	60·4	136·0	54·0	S. W.	·000	Fine, breezy, bright sun.
2 Sunday,	30·068	73	30·031	71·4	61·2	72·0	57·4	59·8	61·0	143·0	55·4	N. W.	·000	Breezy, fine, bright sun.
3 Monday,	30·030	78	29·976	76·4	66·8	77·2	48·0	60·8	62·0	147·6	40·0	S. E.	·000	Fine, breezy, bright sun.
4 Tuesday,	30·040	66	30·019	64·2	57·9	65·4	54·6	58·0	60·8	146·2	49·0	S. W.	·000	Breezy, cloudy, occasional sun.
5 Wednesday,	29·818	65	29·804	63·9	55·4	64·2	57·4	58·0	60·8	125·4	53·6	S. W.	·000	Do.
6 Thursday,	29·980	68	29·954	66·0	57·6	67·4	47·0	58·0	60·0	135·0	39·4	S. E.	·100	Fine, breezy, bright sun.
7 Friday,	29·688	64	29·676	62·4	60·0	63·2	54·4	58·0	60·0	132·0	52·4	S. E.	·150	Cloudy, mild, light rain.
[illegible]	29·776	70	29·745	69·0	62·8	69·8	56·8	58·8	60·4	125·0	52·6	S. W.	·000	Breezy, showery, occasional sun.
[illegible]	29·882	68	29·858	66·8	58·8	67·4	55·4	58·0	60·0	139·0	52·0	S. W.	·000	Breezy, cloudy, occasional sun.
[illegible]	29·946	63	29·938	61·4	54·4	62·6	50·4	55·4	59·0	136·2	45·8	N. W.	·010	Breezy, cloudy, light showers, occasional sun.
[illegible]	30·348	65	30·333	63·8	55·9	64·6	51·2	55·0	58·4	132·0	45·4	S. W.	·000	Breezy, cloudy, occasional sun.
[illegible]	30·428	75	30·385	73·4	61·0	74·2	44·0	57·4	59·2	138·4	38·2	S. W.	·000	Fine, breezy, bright sun.
[illegible]	30·450	73	30·413	72·0	63·0	72·8	57·0	61·0	62·0	151·6	49·0	S. E.	·000	Do.
[illegible]	30·484	76	30·436	75·4	64·8	76·0	53·0	61·8	63·0	146·4	45·0	S. E.	·000	Do.
[illegible]	30·486	78	30·432	77·2	65·8	77·6	50·0	62·4	63·8	137·0	41·0	S. E.	·000	Do.
[illegible]	30·346	86	30·270	85·0	71·0	85·0	52·0	64·2	65·2	150·0	44·6	S. E.	·000	Do.
[illegible]	30·400	70	30·369	69·0	61·4	69·8	58·0	64·0	65·4	154·0	50·0	N. E.	·000	Breezy, cloudy, occasional sun.
[illegible]	30·320	72	30·283	70·8	61·0	71·4	46·4	61·2	64·0	151·0	38·0	S. W.	·000	Do.
[illegible]	30·318	77	30·270	76·0	65·2	76·8	59·6	63·0	64·6	143·0	53·4	S. W.	·000	Fine, breezy, bright sun.
[illegible]	30·330	71	30·299	69·4	63·0	70·6	52·0	63·0	64·4	149·0	43·0	S. W.	·000	Breezy, cloudy, occasional sun.
[illegible]	[illegible]·194	78	30·150	76·8	65·9	77·4	57·8	65·0	66·0	150·0	48·8	S. E.	·000	Fine, breezy, bright sun.
[illegible]	[illegible]·074	70	30·043	68·0	61·6	69·4	59·0	63·0	65·0	152·0	51·4	S. W.	·000	Breezy, cloudy, occasional sun.
[illegible]	[illegible]·116	67	30·095	66·0	58·6	66·8	46·0	60·2	63·4	129·0	38·4	S. W.	·000	Do.
[illegible]	[illegible]·246	73	30·209	72·0	63·4	72·8	46·4	61·4	63·5	140·6	36·8	N. W.	·120	Fine, breezy, bright sun.
[illegible]	[illegible]	74	30·216	73·2	64·0	73·4	51·4	61·4	63·2	[illegible]	41·0	[illegible]	[illegible]	Do.
[illegible]	[illegible]	65	29·981	68·4	63·0	64·0	61·0	61·0	63·0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	65	30·065	63·6	56·6	64·2	44·0	57·0	60·0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	63	29·562	61·6	[illegible]	[illegible]	[illegible]	57·4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	29·570	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

AUGUST, 1876.

Date.		Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
		Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1	Tuesday,	29·934	65	29·921	64·2	55·4	65·1	46·1	55·2	58·2	128·7	40·1	N. W.	·080	Strong breeze, very cold, light showers, bright sun.
2	Wednesday,	29·740	59	29·744	58·1	57·2	59·0	45·0	55·0	57·1	125·0	43·1	S. E.	1·050	Strong breeze, heavy rain, occasional sun.
3	Thursday,	29·430	63	29·425	60·4	56·8	59·8	56·0	55·4	57·2	122·0	52·3	S. W.	·040	Stormy, overcast, light showers, occasional sun.
4	Friday,	29·880	62	29·874	61·4	59·0	61·8	58·2	55·2	57·3	119·0	46·3	N. E.	·010	Calm and overcast, light showers,
5	Saturday,	30·160	68	30·134	66·4	59·0	65 6	50·0	56·2	57·5	131·4	41·0	W.	·010	Do. [occasional sun.
6	Sunday,	30·130	66	30·109	64·8	60·0	60·0	57·0	57·4	59·4	135·8	49·9	S. W.	·050	Breezy, overcast, light showers, occa-
7	Monday,	30·116	75	30·074	74·2	66·1	74·8	61 3	60·1	62·0	131·3	57·4	S. W.	·000	Fine, breezy, bright sun. [sional sun.
8	Tuesday,	30·134	70	30·103	69·2	62·8	70·0	60·0	60·0	61·6	138·0	53·8	S. E.	·000	Breezy, cloudy, occasional sun.
9	Wednesday,	30·022	73	29·985	71·0	62·6	72·4	59·0	61·0	62·4	131·0	49·8	S. W.	·000	Breezy, cloudy, bright sun.
10	Thursday,	30·368	70	30·337	68·8	59·0	69·4	46·0	58·0	61·2	121·0	39·9	N. W.	·000	Fine, breezy, bright sun.
11	Friday,	30·338	72	30·301	71·0	60·4	71·6	47·6	59·0	61·0	129·0	39·8	S. W.	·000	Do.
12	Saturday,	30·218	74	30·176	73·0	64·6	73·8	44·8	60·0	61·8	118·0	41·4	S. E.	·000	Do.
13	Sunday,	29·970	76	30·022	75·4	66·2	75·9	52·2	62·0	63·2	118·0	43·0	N. E.	·000	Do.
14	Monday,	29·992	77	30·044	76·0	68·0	76·8	55·6	62·0	63·6	122·4	47·6	S. E.	·000	Do.
15	Tuesday,	30·008	73	29·991	72·2	65·4	72·9	52·0	62·4	64·0	120·0	48·8	S. E.	·000	Do.
16	Wednesday,	30·040	79	29·986	79·0	68·8	79·4	53·0	63·0	64·4	117·4	48·0	S. E.	·000	Fine, very calm, bright sun.
17	Thursday,	29·934	72	29·897	71·0	64·0	71·8	57·6	63·1	64·2	120·2	49·8	S. E.	·690	Breezy, overcast, occasional sun. [ning.
18	Friday,	29·924	65	29·909	63·8	62·4	64·2	61·0	62·0	63·4	110·0	57·0	S. E.	·170	Cloudy, heavy rain, with thunder & light-
19	Saturday,	29·960	69	29·929	67·4	63·2	68·4	50·2	62·0	63·8	121·4	58·0	S. E.	·020	Breezy, showery, occasional sun.
20	Sunday,	29·904	71	29·873	70·6	62·8	70·8	56·8	62·0	63·6	123·0	50·6	S. E.	·000	Breezy, light showers, bright sun.
21	Monday,	29·954	70	29·923	68·2	63·6	69·4	55·6	61·8	63·4	120·4	47·6	S. E.	·000	Cloudy, mild, occasional sun.
22	Tuesday,	29·974	66	29·953	64·0	56·0	65·0	57·6	60·6	63·0	124·0	52·0	S. E.	·000	Fine, breezy, bright sun.
23	[illegible]	29·948	67	29·923	65·6	52·4	60·2	41·2	57·0	60·4	127·0	33·0	S. W.	·000	Do.

SEPTEMBER, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min	Earth Thermometers 5 Inch.	Earth Thermometers 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Friday,	29·750	61	29·749	59·0	55·8	60·2	47·4	52·4	55·2	127·0	39·6	S.W.	·020	Breezy, showery, bright sun.
2 Saturday,	29·904	62	29·896	60·1	55·2	61·0	48·8	53·2	56·0	116·0	40·4	S.W.	·000	Cloudy, mild, occasional sun.
3 Sunday,	29·954	59	29·951	58·0	53·0	58·8	49·6	53·6	56·0	101·0	41·8	S.E.	·600	Breezy, cloudy, occasional sun.
4 Monday,	29·584	70	29·558	68·0	61·9	69·2	54·0	55·4	57·0	119·0	50·2	S.E.	·590	Breezy, heavy rain, occasional sun.
5 Tuesday,	29·470	63	29·464	61·8	55·6	62·4	55·0	55·0	57·0	110·6	50·0	S.W.	·000	Do.
6 Wednesday,	29·532	63	29·526	62·4	56·2	62·8	51·0	54·4	57·8	124·0	45·6	S.W.	·000	Breezy, cloudy, occasional sun.
7 Thursday,	29·578	63	29·572	62·0	56·9	62·6	48·2	54·0	56·2	120·0	41·0	S.W.	·020	Breezy, showery, bright sun.
8 Friday,	29·790	59	29·799	58·8	53·2	59·4	46·0	52·0	55·0	120·0	37·0	N.W.	·000	Do.
9 Saturday,	29·856	59	29·855	58·0	53·6	59·2	49·4	52·0	54·8	120·2	44·0	N.W.	·010	Breezy, light showers, occasional sun.
10 Sunday,	29·914	60	29·911	58·8	53·0	59·4	49·0	52·2	54·8	126·4	43·0	N.W.	·000	Do.
11 Monday,	29·926	56	29·934	55·4	50·0	56·2	43·8	50·4	53·6	115·0	38·2	N.W.	·000	Breezy, cold, occasional sun.
12 Tuesday,	30·010	54	30·025	53·2	48·8	54·4	47·0	49·6	53·0	115·0	43·8	N.W.	·000	Do.
13 Wednesday,	29·932	58	29·935	57·0	53·0	58·0	48·0	49·6	52·2	95·0	42·0	N.W.	·000	Breezy, cloudy, changeable.
14 Thursday,	29·848	55	29·862	54·2	50·6	55·0	46·2	50·0	52·4	111·2	43·4	N.W.	·000	Breezy, cloudy, occasional sun.
15 Friday,	29·704	60	29·703	58·6	53·8	59·4	37·0	49·9	52·2	115·0	30·3	S.E.	·470	Do.
16 Saturday,	29·556	55	29·571	53·8	53·2	54·2	37·0	50·4	52·8	107·0	44·8	S.E.	·170	Breezy, showery, changeable.
17 Sunday,	29·690	64	29·678	62·4	56·0	63·2	41·2	51·0	53·0	119·0	34·0	S.E.	·130	Breezy, cloudy, light showers, occasional sun.
18 Monday,	29·840	62	29·835	61·2	57·8	62·2	45·8	52·0	53·8	133·4	35·8	S.E.	·000	Breezy, showery, occasional sun.
19 Tuesday,	30·272	63	29·264	62·0	58·0	62·8	46·8	52·0	54·0	122·0	38·2	S.E.	·000	Cloudy, mild, occasional sun.
20 Wednesday,	30·302	69	30·271	68·0	61·8	68·6	49·6	54·0	55·4	112·0	43·2	S.E.	·000	Cloudy, heavy fog, sudden outbursts of sunshine.
21 Thursday,	30·084	70	30·053	69·8	63·0	70·0	53·8	55·0	56·2	120·6	44·0	S.E.	·130	Fine, breezy, bright sun.
22 Friday,	29·828	63	29·820	61·4	59·6	62·0	56·2	55·0	56·4	122·0	50·0	S.E.	·080	Breezy, showery, changeable.
23 Saturday,	29·790	64	29·778	62·4	59·6	63·2	51·0	55·2	56·6	101·0	42·4	S.E.	·260	Cloudy, light showers, occasional sun.
24 Sunday,	29·430	65	29·418	64·0	60·1	65·2	53·1	57·2	55·8	108·0	44·0	W.	·170	Breezy, heavy showers, occasional sun.
25 Monday,	29·920	63	29·912	59·2	57·4	62·0	53·0	54·2	56·0	107·0	48·0	S.W.	·500	Breezy, showery, occasional sun.
26 Tuesday,	29·644	56	29·653	54·0	53·0	55·4	53·0	54·0	56·0	119·0	51·0	S.W.	·040	Breezy, showery, changeable.
27 Wednesday,	29·710	58	29·714	56·2	54·1	57·6	45·0	52·0	54·6	109·0	37·0	N.E.	·000	Breezy, cloudy, changeable.
28 Thursday,	29·480	57	29·491	55·4	52·6	56·2	52·9	52·4	54·8	90·0	49·4	N.E.	·000	Breezy, cloudy, occasional sun.
29 Friday,	29·728	64	29·716	62·8	57·4	63·4	44·0	53·0	54·8	131·6	37·4	N.E.	·020	Fine, breezy, bright sun.
30 Saturday,	29·552	53	29·573	52·6	49·8	53·2	50·2	51·0	53·4	125·8	40·5	N.E.	·360	Breezy, cloudy, light showers.
													3·570	

OCTOBER, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Sunday, .	30·000	55	30·014	53·0	49·6	54·0	48·2	50·4	52·2	107·0	45·2	N.E.	·130	Breezy, showery, occasional sun.
2 Monday, .	29·980	54	29·995	52·2	51·6	53·4	49·6	50·0	52·0	87·0	44·6	N.E.	·720	Do.
3 Tuesday, .	29·684	64	29·672	63·0	60·6	63·8	52·0	52·0	53·4	114·2	49·0	S.E.	·000	Do.
4 Wednesday,	29·660	69	29·631	67·8	61·6	68·2	56·0	54·0	55·2	127·4	49·6	S.W.	·000	Fine, breezy, bright sun.
5 Thursday, .	29·710	62	29·704	61·0	61·8	58·8	56·0	54·0	55·6	129·6	47·8	S.E.	·000	Breezy, cloudy, changeable.
6 Friday, .	29·658	64	29·646	62 8	59·0	63·8	54·4	54·0	55·2	81·4	44·0	S.W.	·000	Fine, breezy, occasional sun.
7 Saturday. .	29·778	69	29·749	68·0	60·8	68·6	55·6	55·0	56·2	119·0	47·0	S.W.	·050	Fine, breezy, bright sun.
8 Sunday, .	29·776	55	29·791	57·0	55·6	57·4	53·6	54·0	55·4	114·0	47·8	S.E.	·500	Cloudy, showery, changeable.
9 Monday, .	29·462	59	29·462	58·0	54·0	58·8	54·8	54·0	55·6	114·6	49·0	S.W.	·040	Breezy, heavy showers, occasional sun.
10 Tuesday, .	29·214	60	29·214	58·2	53·9	59·4	47·4	52·8	54·9	112·4	38·8	S.W.	·800	Breezy, showery, occasional sun.
11 Wednesday,	28·704	60	29·706	58·0	55·0	59·6	48·8	51·0	53·4	123·0	41·6	S.W.	·040	Do.
12 Thursday, .	29·504	65	29·490	63·0	54·6	64·2	45·0	50·4	52·4	111·6	38·0	S.E.	·390	Stormy, heavy showers, occasional sun.
13 Friday, .	29·462	59	29·462	57·6	53·8	58·0	47·6	50·6	52·0	111·0	39·4	S.W.	·160	Do.
14 Saturday, .	29·538	59	29·537	57·4	50·9	58·2	48·8	57·0	52·6	111·2	38·0	S.W.	·000	Do.
15 Sunday, .	29·718	64	29·706	62·0	54·0	63·0	46·0	50·4	52·0	108·0	36·8	S.W.	·000	Fine, mild, bright sun.
16 Monday, .	29·356	57	29·361	55·6	53·0	56·2	54·6	50·0	52·0	98·0	47·2	S.E.	·150	Cloudy, mild, light showers.
17 Tuesday, .	29·552	58	29·556	56·2	54·6	57·4	48·8	50·0	52·0	71·2	41·0	S.E.	·080	Breezy, showery, changeable.
18 Wednesday,	29·668	54	29·684	53·0	52·0	53·6	50·4	50·0	51·8	73·0	45·0	N.W.	·590	Cloudy, showery, changeable.
19 Thursday, .	29·820	54	29·836	52·0	51·6	53·2	49·2	49·0	51·0	75·8	47·0	N.W.	·580	Do.
20 Friday, .	30·154	60	29·151	59·6	55·8	60·2	52·0	51·0	53·0	113·6	50·0	N.E.	·000	Fine, breezy, bright sun.
21 Saturday, .	30·200	54	30·220	52·6	48·6	53·4	50·0	50·4	52·0	103·0	46·4	N.E.	·000	Breezy, cloudy, changeable.
22 Sunday, .	30·212	54	30·227	52·2	48·0	53·8	48·0	49·0	51·2	63·2	41·0	N.E.	·000	Breezy, cloudy, changeable.
23 Monday, .	30·158	56	30·156	53·8	49·0	55·0	48·4	48·6	50·6	99·9	42·0	N.E.	·000	Breezy, cloudy, occasional sun.
24 Tuesday, .	30·080	53	30·100	51·8	48·8	52·4	42·0	48·0	50·0	90·6	33·4	N.E.	·000	Cloudy, mild, changeable.
25 Wednesday,	30·222	60	30·219	58·0	53·8	59·0	46·0	47·8	50·4	88·2	38·8	N.E.	·000	Cloudy, mild, occasional sun.
26 Thursday, .	30·162	54	30·177	53·0	51·4	53·8	45·0	48·0	50·0	74·6	34·8	S.E.	·000	Cloudy, mild, changeable.
27 Friday, .	30·252	55	30·267	53·8	50·2	54·2	46·8	47·4	50·0	59·4	39·2	S.E.	·000	Do.
28 Saturday, .	30·300	53	30·320	52·2	50·0	53·0	47·4	48·0	50·2	62·0	44·4	S.W.	·000	Do.
29 Sunday, .	30·258	55	30·273	53·0	50 0	54·2	46·6	47·0	50·0	80·0	40·2	S.W.	·000	Breezy, cloudy, occasional sun.
30 Monday, .	30·326	56	30·334	54·6	49·8	55·4	45·4	48·0	50·0	95·4	36·9	S.W.	·000	Do.
31 Tuesday, .	30·368	50	30·393	49·0	44·6	49·6	29·8	45·0	48·0	95·4	28·4	N.W.	·000	Fine, breezy, bright sun, light frost.
													4·230	

NOVEMBER, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Wednesday, .	30·400	46	30·436	45·0	42·9	49·1	37·0	42·0	45·4	93·6	30·2	N.W.	·000	Fine, very cold, bright sun.
2 Thursday, .	30·332	51	30·357	49·0	46·8	52·8	29·2	42·4	45·0	96·8	23·2	S.W.	·160	Do.
3 Friday, .	30·162	52	30·182	51·0	50·6	52·0	44·7	44·6	46·0	68·1	37·0	W.	·180	Calm, heavy rain, occasional sun.
4 Saturday, .	30·324	55	30·338	54·0	52·4	54·8	46·4	45·4	47·2	64·8	38·0	N.W.	·000	Cloudy, mild, occasional sun.
5 Sunday, .	30·306	52	30·326	50·0	49·0	51·0	48·2	46·0	48·0	79·0	44·6	S.W.	·000	Breezy, cloudy, changeable.
6 Monday, .	30·320	54	30·334	52·0	50·4	53·0	50·0	47·0	49·0	56·0	45·4	N.E.	·000	Calm, overcast, changeable.
7 Tuesday, .	30·268	48	30·299	46·8	43·0	47·0	42·4	46·0	48·0	58·0	37·6	N.E.	·000	Do.
8 Wednesday, .	30·110	42	30·159	40·8	39·8	41·4	40·5	44·2	46·4	60·2	37·0	N.E.	·140	Cloudy, very cold, light showers. [sun.
9 Thursday, .	30·030	41	30·079	39·8	37·4	40·2	29·0	41·0	44·0	95·0	22·4	N.W.	·240	Breezy, heavy hail and rain, occasional
10 Friday, .	30·070	45	30·113	44·0	39·8	44·8	30·6	40·0	43·0	71·0	25·0	S.W.	·120	Do.
11 Saturday, .	29·650	46	29·687	44·4	40·2	45·2	40·4	40·6	42·8	63·0	34·6	S.W.	·000	Breezy, very cold, light showers.
12 Sunday, .	29·156	44	29·196	43·2	42·0	43·8	40·4	40·4	42·8	51·0	37·0	S.E.	·160	Cloudy, showery, changeable.
13 Monday, .	29·386	47	29·424	46·0	45·0	46·7	42·0	41·8	43·2	47·4	39·8	S.E.	·080	Breezy, showery, changeable.
14 Tuesday, .	29·314	52	29·336	52·4	52·0	53·0	44·6	43·4	44·6	64·8	39·0	S.E.	·540	Breezy, heavy rain, overcast.
15 Wednesday, .	29·376	61	29·376	60·2	56·0	62·0	50·2	47·0	48·2	100·0	41·0	S.W.	·190	Fine, breezy, bright sun, light showers.
16 Thursday, .	29·224	51	29·251	50·0	49·8	51·8	42·0	45·0	47·1	94·0	34·0	N.E.	·590	Breezy, overcast, heavy rain.
17 Friday, .	29·700	59	29·704	58·2	53·2	60·0	42·0	46·8	48·0	86·1	32·0	S.W.	·070	Fine, breezy, bright sun, light showers.
18 Saturday, .	29·750	53	29·771	52·6	52·2	52·8	41·2	45·2	47·0	87·4	32·2	S.W.	·050	Cloudy, calm, light showers. [showers.
19 Sunday, .	29·682	52	29·703	51·0	48·4	51·4	44·6	45·6	47·2	88·2	33·2	S.W.	·000	Fine, breezy, occasional sun, light
20 Monday, .	29·900	51	29·926	50·0	47·9	50·2	42·0	44·6	46·2	80·0	35·1	N.W.	·000	Fine, breezy, occasional sun.
21 Tuesday, .	30·068	52	30·088	51·0	48·3	51·0	42·2	45·2	46·8	82·6	39·2	S.E.	·000	Do.
22 Wednesday, .	30·028	52	30·048	51·2	49·2	51·4	41·1	44·8	46·3	79·6	35·2	S.E.	·000	Do.
23 Thursday, .	29·834	47	29·871	46·1	44·0	46·0	45·2	45·1	46·8	56·0	42·0	S.E.	·120	Stormy, overcast, changeable.
24 Friday, .	29·696	49	29·727	48·2	47·9	48·2	44·0	44·3	46·2	53·0	41·0	S.E.	·210	Calm, overcast, light showers.
25 Saturday, .	29·398	47	29·437	45·6	45·1	46·6	43·8	44·3	46·1	53·0	33·2	S.E.	·200	Calm, overcast, heavy rain. [and mild.
26 Sunday, .	29·348	47	29·391	45·2	45·0	46·9	33·2	42·6	45·0	57·1	25·0	E.	·390	Heavy fog, light drizzling rain, calm
27 Monday, .	29·330	47	29·368	46·0	43·8	46·4	35·1	42·1	44·6	87·0	29·0	S.W.	·000	Fine, breezy, occasional sun.
28 Tuesday, .	29·448	43	29·498	42·2	40·3	42·9	32·2	39·8	42·6	82·9	27·2	S.W.	·000	Fine, occasional sun, slight hoar frost.
29 Wednesday,	29·434	46	29·472	45·2	42·9	45·0	34·0	39·8	42·0	84·0	28·2	S.W.	·030	Do.
30 Thursday, .	29·492	48	29·524	47·0	46·2	47·2	30·2	38·3	40·6	88·0	24·6	S.E.	·210	Cloudy, light showers, changeable.
													3·690	

DECEMBER, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Friday, .	29·168	54	29·185	52·9	52·8	53·8	45·0	42·2	43·4	68·3	40·2	S.E.	·180	Cloudy, showery, sudden outbursts of sunshine.
2 Saturday, .	29·166	50	29·193	49·0	48·6	49·7	43·0	43·2	44·8	71·0	32·6	N.E.	1·670	Fine, breezy, occasional sun.
3 Sunday, .	28·542	50	28·570	48·0	47·2	49·0	48·0	44·0	46·0	67·0	45·0	S.W.	·150	Breezy, light showers, changeable.
4 Monday, .	28·450	48	28·489	47·0	46·2	47·6	46·1	44·2	45·8	62·2	39·0	S.W.	·020	Do.
5 Tuesday, .	28·488	49	28·521	48·4	48·1	48·6	44·3	43·8	45·3	63·1	33·2	S.E.	·530	Cloudy, heavy rain, changeable.
6 Wednesday, .	28·878	49	28·911	48·0	45·2	48·2	43·2	43·2	45·1	82·6	37·0	S.W.	·000	Fine, breezy, occasional sun.
7 Thursday, .	29·170	47	29·208	46·2	45·2	46·9	40·0	43·0	44·6	66·2	30·0	N.W.	·000	Cloudy, overcast, and mild.
8 Friday, .	29·764	44	29·808	43·0	42·0	43·5	32·0	40·8	43·6	84·2	27·2	S.W.	·000	Fine, occasional sun, slight frost.
9 Saturday, .	30·120	47	30·155	46·8	45·8	46·9	37·3	40·8	42·6	90·0	31·0	W.	·000	Fine and calm, slight frost.
10 Sunday, .	30·038	50	30·063	49·4	46·0	50·0	38·0	42·0	43·4	64·0	34·0	S.W.	·000	Fresh breeze, cloudy, occasional sun.
11 Monday, .	29·904	53	29·925	52·0	50·0	52·2	45·0	43·0	44·0	73·2	35·0	S.W.	·120	Cloudy, mild, occasional sun.
12 Tuesday, .	29·518	49	29·550	48·6	45·4	48·9	44·0	43·2	44·6	80·0	35·0	S.W.	·000	Strong breeze, showery, bright sun.
13 Wednesday, .	29·514	50	29·540	49·0	46·4	49·6	34·0	44·3	46·0	76·0	27·2	S.W.	·440	Fresh breeze, cloudy, occasional sun.
14 Thursday, .	29·736	47	29·773	46·0	44·6	46·4	41·0	41·4	43·2	85·0	38·0	S.W.	·000	Fresh breeze, showery, bright sun.
15 Friday, .	29·646	46	29·683	45·2	43·0	45·8	26·2	38·6	41·0	91·0	20·4	S.E.	·170	Cloudy, heavy fog, sharp frost.
16 Saturday, .	29·500	50	29·526	49·2	48·6	50·0	44·0	41·0	42·6	64·2	40·0	S.W.	·420	Fresh breeze, light showers, changeable.
17 Sunday, .	29·500	50	29·526	49·4	48·0	50·0	44·0	42·0	43·8	63·0	36·4	S.E.	·240	Fresh breeze, light showers, occasional sun.
18 Monday, .	29·350	47	29·388	46·4	45·6	46·9	45·6	43·0	44·2	75·0	41·0	S.E.	·070	Cloudy, light showers, changeable.
19 Tuesday, .	28·956	45	29·001	43·9	42·0	44·2	38·0	42·0	44·0	65·0	29·4	S.E.	·120	Do.
20 Wednesday, .	28·642	44	28·687	43·0	42·2	43·6	42·6	41·0	43·0	61·0	37·0	S.E.	·160	Do.
21 Thursday, .	28·862	39	28·923	38·0	37·0	38·8	37·0	39·8	42·0	64·0	33·0	N.E.	·210	Do.
22 Friday, .	29·052	38	29·112	37·4	35·2	37·8	33·0	37·6	40·8	87·6	28·8	S.W.	·000	Fresh breeze, light showers, changeable.
23 Saturday, .	29·248	41	29·303	39·0	36·4	40·4	32·0	36·0	39·0	88·4	26·0	S.W.	·000	Fresh breeze, sharp frost at night.
24 Sunday, .	29·404	41	29·459	39·0	37·0	40·2	28·0	35·0	38·0	72·0	20·0	S.E.	·200	Cloudy, sharp frost at night.
25 Monday, .	29·880	40	29·835	38·2	37·0	40·6	37·0	36·0	38·2	48·0	33·0	S.E.	·040	Stormy, hail and rain showers.
26 Tuesday, .	29·982	41	30·037	39·0	38·0	40·2	37·0	36·0	38·0	51·0	31·0	S.E.	·500	Stormy, very cold and wet.
27 Wednesday, .	29·330	46	29·368	45·2	45·0	45·8	38·0	38·0	40·6	51·0	35·0	S.E.	·070	Strong breeze, light showers.
28 Thursday, .	29·396	53	29·418	51·0	48·2	52·0	43·0	41·2	42·4	70·0	36·4	S.W.	·000	Stormy, showery, occasional sun.
29 Friday, .	29·416	47	29·454	47·6	46·4	47·2	40·0	41·0	42·2	86·0	33·4	S.E.	·360	Cloudy, heavy showers, changeable.
30 Saturday, .	29·066	53	29·088	52·2	50·8	52·8	40·4	42·0	43·0	62·4	35·0	S.E.	·500	Breezy, showery, occasional sun.
31 Sunday, .	28·788	51	28·816	49·8	48·2	50·4	47·0	43·0	44·2	74·2	41·0	S.W.	·040	Stormy, heavy showers, changeable.
													6·210	

INDEX.

MAY, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Monday,	30·110	50	30·145	49·2	45·4	50·2	37·2	44·8	47·4	107·6	31·0	N.E.	·010	Breezy, hail showers, bright sun.
2 Tuesday,	30·262	55	30·276	54·0	46·4	54·8	30·2	43·2	45·2	118·4	26·8	S.E.	·000	Breezy, bright sun, sharp frost. [frost.
3 Wednesday,	30·350	55	30·364	53·6	48·2	54·0	29·6	43·0	45·2	115·8	25·4	S.E.	·000	Breezy, cloudy, occasional sun, sharp
4 Thursday,	30·442	60	30·439	58·0	49·6	59·2	33·8	44·2	46·4	116·4	28·2	S.E.	·000	Fine, breezy, bright sun.
5 Friday,	30·304	60	30·301	58·4	50·2	59·6	36·0	45·2	47·4	109·6	31·0	S.E.	·000	Breezy, very cold, bright sun.
6 Saturday,	30·318	63	30·310	61·2	51·8	62·0	34·8	46·0	47·8	114·8	30·6	S.E.	·000	Fine, breezy, bright sun.
7 Sunday,	30·394	60	30·391	58·0	51·2	59·4	37·2	47·0	48·8	118·0	33·2	S.E.	·000	Do.
8 Monday,	30·438	56	30·446	55·0	49·0	55·8	36·8	47·8	49·0	115·6	31·9	S.E.	·000	Do.
9 Tuesday,	30·448	52	30·468	50·6	48·0	51·4	40·4	47·0	48·6	116·2	33·0	S.E.	·000	Breezy, cold, bright sun.
10 Wednesday,	30·360	52	30·380	51·0	45·8	51·8	42·0	46·8	48·4	108·6	35·2	S.E.	·000	Breezy, cloudy, occasional sun.
11 Thursday,	30·250	57	30·258	55·8	49·2	56·6	42·6	47·2	49·0	114·2	37·0	S.E.	·000	Fine, breezy, bright sun.
12 Friday,	30·276	58	30·279	56·4	49·6	57·4	42·8	47·2	49·4	117·6	34·8	S.E.	·000	Breezy, cloudy, occasional sun.
13 Saturday,	30·378	59	30·375	56·4	49·0	58·4	42·0	48·4	50·2	119·0	37·4	S.E.	·000	Fine, breezy, bright sun.
14 Sunday,	30·180	61	30·177	60·0	52·4	60·6	31·8	47·0	48·6	118·6	29·2	N.E.	·240	Cloudy, mild, occasional sun.
15 Monday,	30·188	54	30·203	52·8	46·2	53·4	42·4	48·0	49·4	122·0	36·6	N.E.	·000	Breezy, heavy showers, bright sun.
16 Tuesday,	30·246	53	30·260	52·0	46·0	52·8	44·8	48·0	50·0	124·0	38·0	N.E.	·010	Breezy, cloudy, light showers.
17 Wednesday,	30·282	56	30·290	55·0	49·2	55·8	43·0	48·6	50·0	119·4	37·6	N.E.	·000	Breezy, cloudy, bright sun.
18 Thursday,	30·332	53	30·347	51·2	47·0	52·0	42·6	48·0	49·8	119·2	35·4	N.E.	·000	Breezy, cloudy, changeable.
19 Friday,	30·420	59	30·417	58·0	51·2	58·8	35·8	47·6	49·4	123·6	31·2	N.E.	·000	Fine, breezy, bright sun.
20 Saturday,	30·370	62	30·362	62·0	57·2	62·2	40·6	50·0	51·2	130·4	36·0	N.E.	·000	Fine, mild, bright sun.
21 Sunday,	30·024	70	29·993	68·8	57·0	69·2	43·9	51·2	52·6	135·0	37·6	N.E.	·260	Fine, breezy, bright sun.
22 Monday,	29·614	62	29·608	60·2	54·0	61·4	49·1	50·4	52·4	136·2	46·2	S.W.	·400	Breezy, showery, occasional sun.
23 Tuesday,	29·654	58	29·658	57·0	52·4	57·6	44·4	49·0	52·4	126·0	48·0	S.W.	·170	Breezy, cloudy, occasional sun.
24 Wednesday,	29·788	55	29·804	53·4	50·0	54·2	46·0	49·0	51·6	129·0	40·4	N.E.	·000	Breezy, showery, occasional sun.
25 Thursday,	29·960	57	29·968	55·2	49·0	56·4	43·9	48·6	51·0	116·4	39·6	N.E.	·000	Breezy, cloudy, occasional sun.
26 Friday,	29·910	60	29·907	58·8	55·0	59·6	44·0	49·0	51·0	119·0	38·8	S.W.	·000	Breezy, cloudy, changeable.
27 Saturday,	30·080	63	30·072	61·0	55·8	62·0	53·6	51·0	52·4	136·0	51·2	S.W.	·000	Breezy, cloudy, occasional sun.
28 Sunday,	30·284	62	30·276	61·0	54·0	61·8	49·8	51·0	52·8	127·0	47·0	S.W.	·000	Do.
29 Monday,	30·204	62	30·196	60·9	54·8	61·4	51·0	51·0	53·0	105·0	49·8	S.W.	·000	Do.
30 Tuesday,	30·052	61	30·049	60·0	54·4	60·8	53·6	51·6	53·6	125·0	50·6	S.W.	·000	Breezy, overcast, occasional sun.
31 Wednesday,	30·220	60	30·217	58·2	51·0	59·4	45·0	50·6	53·0	126·6	41·4	N.W.	·000	Cloudy, occasional sun, thunder.
													1·090	

JUNE, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Thermometer. Shade Thermometers. Dry B.	Wet B.	Max.	Min.	Earth Thermometers. 5 Inch.	10 Inch.	Grass Thermometers freely exposed. Max.	Min.	Wind Direction.	Rain Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Thursday, .	30·250	71	30·219	70·6	59·9	70·8	42·0	52·0	54·0	145·2	37·8	S.W.	·000	Fine, breezy, bright sun.
2 Friday, .	30·090	65	30·077	64·4	58·4	65·0	46·2	52·2	55·0	132·4	40·0	S.E.	·020	Breezy, cloudy, occasional bright sun.
3 Saturday, .	29·544	55	29 559	53·8	53·2	54·0	48·6	53·0	54·6	119·0	42·0	S.W.	·200	Breezy, showery, changeable.
4 Sunday, .	29·796	58	29·800	56·8	51·6	57·2	44·0	50·4	53·0	99·0	40·0	S.W.	·180	Breezy, occasional sun, light showers.
5 Monday, .	29·830	60	29·829	59·0	50·8	59·8	50·0	51·0	53·4	129·0	48·2	S.W.	·000	Breezy, showery, occasional sun.
6 Tuesday, .	29·966	62	29·958	60·6	52·0	61·4	41·0	50·6	53·0	125·0	34·4	S.W.	·020	Fine, breezy, bright sun.
7 Wednesday,.	29·906	59	29·903	57·9	50·6	58·6	46·0	50·4	53·2	134·6	41·0	S.W.	·010	Breezy, light showers, occasional sun.
8 Thursday, .	29·814	56	29·823	54·0	52·6	55·2	43·6	50·0	52·0	109·0	38·2	S.W.	·480	Cloudy, light showers, changeable.
9 Friday, .	29·952	62	29·944	60·6	52·8	61·4	45·8	50·4	53·0	129·0	41·0	N.E.	·000	Breezy, heavy showers, bright sun.
10 Saturday, .	30·316	66	30·297	65·2	55·2	66·2	41·0	51·0	53·2	134·0	33·6	S.W.	·000	Fine, breezy, bright sun.
11 Sunday, .	30·184	72	30·147	70·2	63·6	71·2	49·0	53·6	55·0	141·0	41·0	S.W.	·000	Breezy, cloudy, bright sun.
12 Monday, .	30·084	66	30·063	64·8	51·0	65·4	55·9	54·8	56·2	136·2	54·0	S.W.	·000	Breezy, cloudy, occasional sun.
13 Tuesday, .	30·024	57	30·032	55·2	53 0	56·2	47·0	52·0	55·0	123·0	35·0	S.W.	·400	Do.
14 Wednesday,.	29·918	63	29·910	61·6	54·8	62·0	44·6	51·0	54·2	127·0	35·4	S.W.	·100	Breezy, heavy showers, occasional sun.
15 Thursday, .	29·746	59	29·745	58·8	55·0	59·2	47·6	51·0	53·6	133·2	43·8	S.W.	·080	Breezy, showery, bright sun.
16 Friday, .	29·854	62	29·848	60·0	52·9	61·0	41·4	50·4	53·0	131·4	34·6	S.W.	·070	Breezy, showery, occasional sun.
17 Saturday, .	29·580	63	29·574	61·0	57·2	62·0	44·8	51·2	53·6	129·0	37·0	S.W.	·000	Do.
18 Sunday, .	30·012	66	29·991	65·0	56·8	65·9	48·2	52·0	54·0	124·0	44·0	S.W.	·000	Fine, breezy, bright sun.
19 Monday, .	29·940	66	29·919	64·2	58·8	65·2	55·6	54·0	55·4	133·6	50·4	S.W.	·000	Breezy, cloudy, occasional sun.
20 Tuesday, .	29·906	77	29·858	75·8	65·6	76·4	55 2	56·4	58·2	136·0	49·2	S.W.	·000	Stormy, bright sunshine.
21 Wednesday,.	29·820	68	29·794	65·8	60·0	66·2	57·6	57·2	58·4	140·6	51·0	S.E.	·010	Breezy, cloudy, occasional sun.
22 Thursday, .	30·056	67	30·035	66·0	58·0	57·0	45·0	55·6	57·0	128·0	37·8	S.E.	·000	Fine, breezy, light showers, bright sun.
23 Friday, .	30·022	70	29 991	70·0	58 4	70·2	44·0	55·2	56·8	136·0	38·2	S.E.	·000	Fine, breezy, bright sunshine.
24 Saturday, .	29·992	65	29·977	64·0	58·9	64·6	38·4	55·2	57·4	131·4	46·4	S.E.	·000	Cloudy, heavy fog, changeable.
25 Sunday, .	30·180	69	29·950	67·2	56·2	68·0	51·0	56·4	57·6	130·6	45·0	S.E.	·000	Breezy, bright sun.
26 Monday, .	30·188	78	30·134	77·4	64·0	78·0	51·0	59·6	59·8	139·0	45 0	S.E.	·000	Fine, warm, bright sun.
27 Tuesday, .	30·266	75	30·223	74·8	65·8	75·0	51·2	59·6	60·8	139·4	45·0	S.E.	·000	Do. [sun.
28 Wednesday,.	30·244	62	30·236	61·0	55·6	61·6	51·0	57·0	60·0	137·0	44·8	N.W.	·000	Breezy, cloudy, changeable, occasional
29 Thursday, .	30·126	61	30·123	59 6	54·0	60·0	51·0	55·4	58·2	91·6	47·2	N.W.	·000	Do.
30 Friday, .	29·990	70	29·979	68·8	63·2	69·4	56·0	57·2	49·0	124·0	48·2	S.W.	·000	Fine, breezy, bright sun.
													1 570	

JULY, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Saturday, .	29·854	74	29·812	72·2	63·6	73·0	57·8	59·0	60·4	136·0	54·0	S. W.	·000	Fine, breezy, bright sun.
2 Sunday, .	30·068	73	30·031	71·4	61·2	72·0	57·4	59·8	61·0	143·0	55·4	N. W.	·000	Breezy, fine, bright sun.
3 Monday, .	30·030	78	29·976	76·4	66·8	77·2	48·0	60·8	62·0	147·6	40·0	S. E.	·000	Fine, breezy, bright sun.
4 Tuesday, .	30·040	66	30·019	64·2	57·9	65·4	54·6	58·0	60·8	146·2	49·0	S. W.	·000	Breezy, cloudy, occasional sun.
5 Wednesday, .	29·818	65	29·804	63 9	55·4	64·2	57·4	58·0	60·8	125·4	53·6	S. W.	·000	Do.
6 Thursday, .	29·980	68	29·954	66 0	57·6	67·4	47·0	58·0	60·0	135·0	39·4	S. E.	·100	Fine, breezy, bright sun.
7 Friday, .	29·688	64	29·676	62·4	60·0	63·2	54·4	58·0	60·0	132·0	52·4	S. E.	·150	Cloudy, mild, light rain.
8 Saturday, .	29·776	70	29·745	69·0	62·8	69·8	56·8	58·8	60·4	125·0	52·6	S. W.	·000	Breezy, showery, occasional sun.
9 Sunday, .	29·882	68	29·858	66·8	58·8	67·4	55·4	58·0	60·0	139·0	52·0	S. W.	·000	Breezy, cloudy, occasional sun.
10 Monday, .	29·946	63	29·938	61·4	54·4	62·6	50·4	55·4	59·0	136·2	45·8	N. W.	·010	Breezy, cloudy, light showers, occasional sun.
11 Tuesday, .	30·348	65	30·333	63·8	55·9	64·6	51·2	55·0	58·4	132·0	45·4	S. W.	·000	Breezy, cloudy, occasional sun.
12 Wednesday, .	30·428	75	30·385	73·4	61·0	74·2	44·0	57·4	59·2	138·4	38·2	S. W.	·000	Fine, breezy, bright sun.
13 Thursday, .	30·450	73	30·413	72·0	63·0	72·8	57·0	61·0	62·0	151·6	49·0	S. E.	·000	Do.
14 Friday, .	30·484	76	30·436	75·4	64·8	76·0	53·0	61·8	63·0	146·4	45·0	S. E.	·000	Do.
15 Saturday, .	30·486	78	30·432	77·2	65·8	77·6	50·0	62·4	63·8	137·0	41·0	S. E.	·000	Do.
16 Sunday, .	30·346	86	30·270	85·0	71·0	85·0	52·0	64·2	65·2	150·0	44·6	S. E.	·000	Do.
17 Monday, .	30·400	70	30·369	69·0	61·4	69·8	58·0	64·0	65·4	154·0	50·0	N. E.	·000	Breezy, cloudy, occasional sun.
18 Tuesday, .	30·320	72	30·283	70·8	61·0	71·4	46·4	61·2	64·0	151·0	38·0	S. W.	·000	Do.
19 Wednesday, .	30·318	77	30·270	76·0	65·2	76·8	59·6	63·0	64·6	143·0	53·4	S. W.	·000	Fine, breezy, bright sun.
20 Thursday, .	30·330	71	30·299	69·4	63·0	70·6	52·0	63·0	64·4	149·0	43·0	S. W.	·000	Breezy, cloudy, occasional sun.
21 Friday, .	30·194	78	30·150	76·8	65·9	77·4	57·8	65·0	66·0	150·0	48·8	S. E.	·000	Fine, breezy, bright sun.
22 Saturday, .	30·074	70	30·043	68·0	61·6	69·4	59·0	63·0	65·0	152·0	51·4	S. W.	·000	Breezy, cloudy, occasional sun.
23 Sunday, .	30·116	67	30·095	66·0	58·6	66·8	46·0	60·2	63·4	129·0	38·4	S. W.	·000	Do.
24 Monday, .	30·246	73	30·209	72·0	63·4	72·8	46·4	61·4	63·3	140·6	36·8	N. W.	·000	Fine, breezy, bright sun.
25 Tuesday, .	30·258	74	30·216	73·2	64·0	73·4	51·4	61·4	63·2	159·0	41·0	S. W.	·120	Do.
26 Wednesday, .	29·946	65	29·931	63·4	63·0	64·0	61·0	61·0	63·0	143·0	57·8	S. W.	·760	Breezy, showery, changeable.
27 Thursday, .	30·100	65	30·085	63·6	56·8	64·2	44·6	57·0	60·6	128·5	38·0	S. W.	·220	Breezy, cloudy, occasional sun.
28 Friday, .	29·568	63	29·562	61·6	55·8	62·0	54·2	57·4	60·8	136·2	48·2	S. W.	·000	Breezy, showery, occasional sun.
29 Saturday, .	29·894	68	29·870	61·8	59 0	62·0	58·0	57·2	59·2	129·4	41·9	S. W.	·000	Fine, breezy, bright sun.
30 Sunday, .	29·794	70	29·765	68·2	61·1	69·1	55·2	58·2	60·7	140·9	40·6	S. W.	·090	Fine, breezy, overcast, with outbursts of sunshine.
31 Monday, .	29·634	63	29·628	61·4	54·6	62·0	55·2	58·0	60·2	139·2	48·2	N. E.	·040	Strong breeze, overcast, light showers, occasional sun.
													1·400	

AUGUST, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Tuesday, .	29·934	65	29·921	64·2	55·4	65·1	46·1	55·2	58·2	128·7	40·1	N.W.	·080	Strong breeze, very cold, light showers, bright sun.
2 Wednesday,	29·740	59	29·744	58·1	57·2	59·0	45·0	55·0	57·1	125·0	43·1	S.E.	1·050	Strong breeze, heavy rain, occasional sun.
3 Thursday, .	29·430	63	29·425	60·4	56·8	59·8	56·0	55·4	57·2	122·0	52·3	S.W.	·040	Stormy, overcast, light showers, occasional sun.
4 Friday, .	29·880	62	29·874	61·4	59·0	61·8	58·2	55·2	57·3	119·0	46·3	N.E.	·010	Calm and overcast, light showers,
5 Saturday, .	30·160	68	30·134	66·4	59·0	65·6	50·0	56·2	57·5	131·4	41·0	W.	·010	Do. [occasional sun.
6 Sunday, .	30·130	66	30·109	64·8	60·0	60·0	57·0	57·4	59·4	135·8	49·9	S.W.	·050	Breezy, overcast, light showers, occa-
7 Monday, .	30·116	75	30·074	74·2	66·1	74·8	61·3	60·1	62·0	131·3	57·4	S.W.	·000	Fine, breezy, bright sun. [sional sun.
8 Tuesday, .	30·134	70	30·103	69·2	62·8	70·0	60·0	60·0	61·6	138·0	53·8	S.E.	·000	Breezy, cloudy, occasional sun.
9 Wednesday,	30·022	73	29·985	71·0	62·6	72·4	59·0	61·0	62·4	131·0	49·8	S.W.	·000	Breezy, cloudy, bright sun.
10 Thursday, .	30·368	70	30·337	68·8	59·0	69·4	46·0	58·0	61·2	121·0	39·9	N.W.	·000	Fine, breezy, bright sun.
11 Friday, .	30·338	72	30·301	71·0	60·4	71·6	47·6	59·0	61·0	129·0	39·8	S.W.	·000	Do.
12 Saturday, .	30·218	74	30·176	73·0	64·6	73·8	44·8	60·0	61·8	118·0	41·4	S.E.	·000	Do.
13 Sunday, .	29·970	76	30·022	75·4	66·2	75·9	52·2	62·0	63·2	118·0	43·0	N.E.	·000	Do.
14 Monday, .	29·992	77	30·044	76·0	68·0	76·8	55·6	62·0	63·6	122·4	47·6	S.E.	·000	Do.
15 Tuesday, .	30·008	73	29·991	72·2	65·4	72·9	52·0	62·4	64·0	120·0	48·8	S.E.	·000	Do.
16 Wednesday,	30·040	79	29·986	79·0	68·8	79·4	53·0	63·0	64·4	117·4	48·0	S.E.	·000	Fine, very calm, bright sun.
17 Thursday, .	29·934	72	29·897	71·0	64·0	71·8	57·6	63·1	64·2	120·2	49·8	S.E.	·690	Breezy, overcast, occasional sun. [ning
18 Friday, .	29·924	65	29·909	63·8	62·4	64·2	61·0	62·0	63·4	110·0	57·0	S.E.	·170	Cloudy, heavy rain, with thunder & light-
19 Saturday, .	29·960	69	29·929	67·4	63·2	68·4	50·2	62·0	63·8	121·4	58·0	S.E.	·020	Breezy, showery, occasional sun.
20 Sunday, .	29·904	71	29·873	70·6	62·8	70·8	56·8	62·0	63·6	123·0	50·6	S.E.	·000	Breezy, light showers, bright sun.
21 Monday, .	29·954	70	29·923	68·2	63·6	69·4	55·6	61·8	63·4	120·4	47·6	S.E.	·000	Cloudy, mild, occasional sun.
22 Tuesday, .	29·974	66	29·953	64·0	56·0	65·0	57·6	60·6	63·0	124·0	52·0	S.E.	·000	Fine, breezy, bright sun.
23 Wednesday,	29·948	67	29·923	65·6	52·4	60·2	41·2	57·0	60·4	127·0	33·0	S.W.	·000	Do.
24 Thursday, .	29·922	62	29·817	60·0	54·0	61·0	45·0	55·0	59·0	126·4	38·0	N.W.	·020	Breezy, cloudy, occasional sun. [shine.
25 Friday, .	30·136	63	30·131	61·0	59·0	62·0	39·2	64·0	67·0	123·2	52·4	N.W.	·000	Breezy, cloudy, with outbursts of sun-
26 Saturday, .	29·854	61	29·856	59·0	55·6	60·2	48·0	53·2	56·2	120·0	42·0	S.W.	·000	Breezy, cloudy, changeable.
27 Sunday, .	29·890	63	29·884	62·0	55·0	62·8	52·8	54·2	56·6	109·0	47·8	S.W.	·020	Fine, breezy, bright sun.
28 Monday, .	29·879	67	29·860	65·8	60·0	66·4	54·0	56·8	58·0	120·0	48·0	S.W.	·000	Breezy, light showers, occasional sun.
29 Tuesday, .	29·772	65	29·758	64·0	52·6	64·8	51·4	56·0	58·2	132·0	46·2	S.W.	·040	Do.
30 Wednesday,	29·370	60	29·370	58·8	56·4	59·2	51·0	55·0	57·2	121·0	42·0	S.E.	·190	Do.
31 Thursday, .	29·396	61	29·396	60·0	54·0	60·8	44·0	53·0	55·6	121·0	38·6	S.W.	·000	Stormy, showery, occasional sun.
													2·390	

SEPTEMBER, 1876.

Date.	Barometer.			Thermometer.								Wind.	Rain.	Remarks.
	Uncorrected.	Attached Thermometer.	Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers.				Earth Thermometers		Grass Thermometers freely exposed.		Direction.	Previous 24 Hours.	
				Dry B.	Wet B.	Max.	Min	5 Inch.	10 Inch.	Max.	Min.			
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Friday,	29·750	61	29·749	59·0	55·8	60·2	47·4	52·4	55·2	127·0	39·6	S.W.	·020	Breezy, showery, bright sun.
2 Saturday,	29·904	62	29·896	60·1	55·2	61·0	48·8	53·2	56·0	126·0	40·4	S.W.	·000	Cloudy, mild, occasional sun.
3 Sunday,	29·954	59	29·951	58·0	53·0	58·8	49·6	53·6	56·0	101·0	41·8	S E.	·600	Breezy, cloudy, occasional sun.
4 Monday,	29·584	70	29·558	68·0	61·9	69·2	54·0	55·4	57·0	119·0	50·2	S.E.	·590	Breezy, heavy rain, occasional sun.
5 Tuesday,	29·470	63	29·464	61·8	55·6	62·4	55·0	55·0	57·0	110·6	50·0	S.W.	·000	Do.
6 Wednesday,	29·532	63	29·526	62·4	56·2	62·8	51·0	54·4	57·8	124·0	45·6	S.W.	·000	Breezy, cloudy, occasional sun.
7 Thursday,	29·578	63	29·572	62·0	56·9	62·6	48·2	54·0	56·2	120·0	41·0	S.W.	·020	Breezy, showery, bright sun.
8 Friday,	29·790	59	29·799	58·8	53·2	59·4	46·0	52·0	55·0	130·0	37·0	N.W.	·000	Do.
9 Saturday,	29·856	59	29·855	58·0	53·6	59·2	49·4	52·0	54·8	120·2	44·0	N.W.	·010	Breezy, light showers, occasional sun.
10 Sunday,	29·914	60	29·911	58·8	53·0	59·4	49·0	52·2	54·8	126·4	43·0	N.W.	·000	Do.
11 Monday,	29·926	56	29·934	55·4	50·0	56·2	43·8	50·4	53·6	115·0	38·2	N.W.	·000	Breezy, cold, occasional sun.
12 Tuesday,	30·010	54	30·025	53·2	48·8	54·4	47·0	49·6	53·0	115·0	43·8	N.W.	·000	Do.
13 Wednesday,	29·932	58	29·935	57·0	53·0	58·0	48·0	49·6	52·2	95·0	42·0	N.W.	·000	Breezy, cloudy, changeable.
14 Thursday,	29·848	55	29·862	54·2	50·6	55·0	46·2	50·0	52·4	111·2	43·4	N.W.	·000	Breezy, cloudy, occasional sun.
15 Friday,	29·704	60	29·703	58·6	53·8	59·4	37·0	49·9	52·2	115·0	30·3	S.E.	·470	Do.
16 Saturday,	29·556	55	29·571	53·8	53·2	54·2	37·0	50·4	52·8	107·0	44·8	S.E.	·170	Breezy, showery, changeable.
17 Sunday,	29·690	64	29·678	62·4	56·0	63·2	41·2	51·0	53·0	119·0	34·0	S.E.	·130	Breezy, cloudy, light showers, occasional sun.
18 Monday,	29·840	62	29·835	61·2	57·8	62·2	45·8	52·0	53·8	133·4	35·8	S.E.	·000	Breezy, showery, occasional sun.
19 Tuesday,	30·272	63	29·264	62·0	58·0	62·8	46·8	52·0	54·0	122·0	38·2	S.E.	·000	Cloudy, mild, occasional sun.
20 Wednesday,	30·302	69	30·271	68·0	61·8	68·6	49·6	54·0	55·4	112·0	43·2	S.E.	·000	Cloudy, heavy fog, sudden outbursts of sunshine.
21 Thursday,	30·084	70	30·053	69·8	63·0	70·0	53·8	55·0	56·2	120·6	44·0	S.E.	·130	Fine, breezy, bright sun.
22 Friday,	29·828	63	29·820	61·4	59·6	62·0	56·2	55·0	56·4	122·0	50·0	S.E.	·080	Breezy, showery, changeable.
23 Saturday,	29·790	64	29·778	62·4	59·6	63·2	51·0	55·2	56·6	101·0	42·4	S.E.	·260	Cloudy, light showers, occasional sun.
24 Sunday,	29·430	65	29·418	64·0	60·1	65·2	53·1	57·2	55·8	108·0	44·0	W.	·170	Breezy, heavy showers, occasional sun.
25 Monday,	29·920	63	29·912	59·2	57·4	62·0	53·0	54·2	56·0	107·0	48·0	S.W.	·500	Breezy, showery, occasional sun.
26 Tuesday,	29·644	56	29·653	54·0	53·0	55·4	53·0	54·0	56·0	119·0	51·0	S W.	·040	Breezy, showery, changeable.
27 Wednesday,	29·710	58	29·714	56·2	54·1	57·6	45·0	52·0	54·6	109·0	37·0	N.E	·000	Breezy, cloudy, changeable.
28 Thursday,	29·480	57	29·491	55·4	52·6	56·2	52·9	52·4	54·8	90·0	49·4	N.E.	·000	Breezy, cloudy, occasional sun.
29 Friday,	29·728	64	29·716	62·8	57·4	63·4	44·0	53·0	54·8	131·6	37·4	N.E.	·020	Fine, breezy, bright sun.
30 Saturday,	29·552	53	29·578	52·6	49·8	53·2	50·2	51·0	53·4	125·8	40·5	N.E.	·360	Breezy, cloudy, light showers.
													3·570	

OCTOBER, 1876.

Date.	Barometer.			Thermometer.								Wind.	Rain.	Remarks.
	Uncorrected.	Attached Thermometer.	Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers.				Earth Thermometers.		Grass Thermometers freely exposed.		Direction.	Previous 24 Hours.	
				Dry B.	Wet B.	Max.	Min.	5 Inch.	10 Inch.	Max.	Min.			
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Sunday,	30·000	55	30·014	53·0	49·6	54·0	48·2	50·4	52·2	107·0	45·2	N.E.	·130	Breezy, showery, occasional sun.
2 Monday,	29·980	54	29·995	52·2	51·6	53·4	49·6	50·0	52·0	87·0	44·6	N.E.	·720	Do.
3 Tuesday,	29·684	64	29·672	63·0	60·6	63·8	52·0	52·0	53·4	114·2	49·0	S.E.	·000	Do.
4 Wednesday,	29·660	69	29·631	67·8	61·6	68·2	56·0	54·0	55·2	127·4	49·6	S.W.	·000	Fine, breezy, bright sun.
5 Thursday,	29·710	62	29·704	61·0	61·8	58·8	56·0	54·0	55·6	129·6	47·8	S.E.	·000	Breezy, cloudy, changeable.
6 Friday,	29·658	64	29·646	62·8	59·0	63·8	54·4	54·0	55·2	81·4	44·0	S.W.	·010	Fine, breezy, occasional sun.
7 Saturday.	29·778	69	29·749	68·0	60·8	68·6	55·6	55·0	56·2	119·0	47·0	S.W.	·050	Fine, breezy, bright sun.
8 Sunday,	29·776	55	29·791	57·0	55·6	57·4	53·6	54·0	55·4	114·0	47·8	S.E.	·500	Cloudy, showery, changeable.
9 Monday,	29·462	59	29·462	58·0	54·0	58·8	54·8	54·0	55·6	114·6	49·0	S.W.	·040	Breezy, heavy showers, occasional sun.
10 Tuesday,	29·214	60	29·214	58·2	53·9	59·4	47·4	52·8	54·9	112·4	38·8	S.W.	·800	Breezy, showery, occasional sun.
11 Wednesday,	28·704	60	29·706	58·0	55·0	59·6	48·8	51·0	53·4	123·0	41·6	S.W.	·040	Do.
12 Thursday,	29·504	65	29·490	63·0	54·6	64·2	45·0	50·4	52·4	111·6	38·0	S.E.	·390	Stormy, heavy showers, occasional sun.
13 Friday,	29·462	59	29·462	57·6	53·8	58·0	47·6	50·6	52·0	111·0	39·4	S.W.	·160	Do.
14 Saturday,	29·538	59	29·537	57·4	50·9	58·2	48·8	57·0	52·6	111·2	38·0	S.W.	·000	Do.
15 Sunday,	29·718	64	29·706	62·0	54·0	63·0	46·0	50·4	52·0	108·0	36·8	S.W.	·000	Fine, mild, bright sun.
16 Monday,	29·356	57	29·361	55·6	53·0	56·2	54·6	50·0	52·0	98·0	47·2	S.E.	·150	Cloudy, mild, light showers.
17 Tuesday,	29·552	58	29·556	56·2	54·6	57·4	48·8	50·0	52·0	71·2	41·0	S.E.	·080	Breezy, showery, changeable.
18 Wednesday,	29·668	54	29·684	53·0	52·0	53·6	50·4	50·0	51·8	73·0	45·0	N.W.	·590	Cloudy, showery, changeable.
19 Thursday,	29·820	54	29·836	52·0	51·6	53·2	49·2	49·0	51·0	75·8	47·0	N.W.	·580	Do.
20 Friday,	30·154	60	29·151	59·6	55·8	60·2	52·0	51·0	53·0	113·6	50·0	N.E.	·000	Fine, breezy, bright sun.
21 Saturday,	30·200	54	30·220	52·6	48·6	53·4	50·0	50·4	52·0	103·0	46·4	N.E.	·000	Breezy, cloudy, changeable.
22 Sunday,	30·212	54	30·227	52·2	48·0	53·8	48·0	49·0	51·2	63·2	41·0	N.E.	·000	Breezy, cloudy, changeable.
23 Monday,	30·158	56	30·156	53·8	49·0	55·0	48·4	48·6	50·6	99·9	42·0	N.E.	·000	Breezy, cloudy, occasional sun.
24 Tuesday,	30·080	53	30·100	51·8	48·8	52·4	42·0	48·0	50·0	90·6	33·4	N.E.	·000	Cloudy, mild, changeable.
25 Wednesday,	30·222	60	30·219	58·0	53·8	59·0	46·0	47·8	50·4	88·2	38·8	N.E.	·000	Cloudy, mild, occasional sun.
26 Thursday,	30·162	54	30·177	53·0	51·4	53·8	45·0	48·0	50·0	74·6	34·8	S.E.	·000	Cloudy, mild, changeable.
27 Friday,	30·252	55	30·267	53·8	50·2	54·2	46·8	47·4	50·0	59·4	39·2	S.E.	·000	Do.
28 Saturday,	30·300	53	30·320	52·2	50·0	53·0	47·4	48·0	50·2	62·0	44·4	S.W.	·000	Do.
29 Sunday,	30·258	55	30·273	53·0	50·0	54·2	46·6	47·0	50·0	80·0	40·2	S.W.	·000	Breezy, cloudy, occasional sun.
30 Monday,	30·326	56	30·334	54·6	49·8	55·4	45·4	48·0	50·0	95·4	36·9	S.W.	·000	Do.
31 Tuesday,	30·368	50	30·393	49·0	44·6	49·6	29·8	45·0	48·0	95·4	28·4	N.W.	·000	Fine, breezy, bright sun, light frost.
													4·230	

NOVEMBER, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Wednesday, .	30·400	46	30·436	45·0	42·9	49·1	37·0	42·0	45·4	93·6	30·2	N.W.	·000	Fine, very cold, bright sun.
2 Thursday, .	30·332	51	30·357	49·0	46·8	52·8	29·2	42·4	45·0	96·8	23·2	S.W.	·160	Do.
3 Friday, .	30·162	52	30·182	51·0	50·6	52·0	44·7	44·6	46·0	68·1	37·0	W.	·180	Calm, heavy rain, occasional sun.
4 Saturday, .	30·324	55	30·338	54·0	52·4	54·8	46·4	45·4	47·2	64·8	38·0	N.W.	·000	Cloudy, mild, occasional sun.
5 Sunday, .	30·306	52	30·326	50·0	49·0	51·0	48·2	46·0	48·0	79·0	44·6	S.W.	·000	Breezy, cloudy, changeable.
6 Monday, .	30·320	54	30·334	52·0	50·4	53·0	50·0	47·0	49·0	56·0	45·4	N.E.	·000	Calm, overcast, changeable.
7 Tuesday, .	30·268	48	30·299	46·8	43·0	47·0	42·4	46·0	48·0	58·0	37·6	N.E.	·000	Do.
8 Wednesday, .	30·110	42	30·159	40·8	39·8	41·4	40·5	44·2	46·4	60·2	37·0	N.E.	·140	Cloudy, very cold, light showers. [sun.
9 Thursday, .	30·030	41	30·079	39·8	37·4	40·2	29·0	41·0	44·0	95·0	22·4	N.W.	·240	Breezy, heavy hail and rain, occasional
10 Friday, .	30·070	45	30·113	44·0	39·8	44·8	30·6	40·0	43·0	71·0	25·0	S.W.	·120	Do.
11 Saturday, .	29·650	46	29·687	44·4	40·2	45·2	40·4	40·6	42·8	63·0	34·6	S.W.	·000	Breezy, very cold, light showers.
12 Sunday, .	29·156	44	29·196	43·2	42·0	43·8	40·4	40·4	42·8	51·0	37·0	S.E.	·160	Cloudy, showery, changeable.
13 Monday, .	29·386	47	29·424	46·0	45·0	46·7	42·0	41·8	43·2	47·4	39·8	S.E.	·080	Breezy, showery, changeable.
14 Tuesday, .	29·314	52	29·336	52·4	52·0	53·0	44·6	43·4	44·6	64·8	39·0	S.E.	·540	Breezy, heavy rain, overcast.
15 Wednesday, .	29·376	61	29·376	60·2	56·0	62·0	50·2	47·0	48·2	100·0	41·0	S.W.	·190	Fine, breezy, bright sun, light showers.
16 Thursday, .	29·224	51	29·251	50·0	49·8	51·8	42·0	45·0	47·1	94·0	34·0	N.E.	·590	Breezy, overcast, heavy rain.
17 Friday, .	29·700	59	29·704	58·2	53·2	60·0	42·0	46·8	48·0	86·1	32·0	S.W.	·070	Fine, breezy, bright sun, light showers.
18 Saturday, .	29·750	53	29·771	52·6	52·2	52·8	41·2	45·2	47·0	87·4	32·2	S.W.	·050	Cloudy, calm, light showers. [showers.
19 Sunday, .	29·682	52	29·703	51·0	48·4	51·4	44·6	45·6	47·2	88·2	33·2	S.W.	·000	Fine, breezy, occasional sun, light
20 Monday, .	29·900	51	29·926	50·0	47·9	50·2	42·0	44·6	46·2	80·0	35·1	N.W.	·000	Fine, breezy, occasional sun.
21 Tuesday, .	30·068	52	30·088	51·0	48·3	51·0	42·2	45·2	46·8	82·6	39·2	S.E.	·000	Do.
22 Wednesday, .	30·028	52	30·048	51·2	49·2	51·4	41·1	44·8	46·3	79·6	35·2	S.E.	·000	Do.
23 Thursday, .	29·834	47	29·871	46·1	44·0	46·0	45·2	45·1	46·8	56·0	42·0	S.E.	·120	Stormy, overcast, changeable.
24 Friday, .	29·696	49	29·727	48·2	47·9	48·2	44·0	44·3	46·2	53·0	41·0	S.E.	·210	Calm, overcast, light showers.
25 Saturday, .	29·398	47	29·437	45·6	45·1	46·6	43·8	44·3	46·1	53·0	33·2	S.E.	·200	Calm, overcast, heavy rain. [and mild.
26 Sunday, .	29·348	47	29·391	45·2	45·0	46·9	33·2	42·6	45·0	57·1	25·0	E.	·390	Heavy fog, light drizzling rain, calm
27 Monday, .	29·330	47	29·368	46·0	43·8	46·4	35·1	42·1	44·6	87·0	29·0	S.W.	·000	Fine, breezy, occasional sun.
28 Tuesday, .	29·448	43	29·498	42·2	40·3	42·9	32·2	39·8	42·6	82·9	27·2	S.W.	·000	Fine, occasional sun, slight hoar frost.
29 Wednesday,	29·434	46	29·472	45·2	42·9	45·0	34·0	39·8	42·0	84·0	28·2	S.W.	·030	Do.
30 Thursday, .	29·492	48	29·524	47·0	46·2	47·2	30·2	38·3	40·6	88·0	24·6	S.E.	·210	Cloudy, light showers, changeable.
													3·680	

DECEMBER, 1876.

Date.	Barometer. Uncorrected.	Barometer. Attached Thermometer.	Barometer. Reduced to 32° F. at the Mean Sea Level, 57 Ft.	Shade Thermometers. Dry B.	Shade Thermometers. Wet B.	Shade Thermometers. Max.	Shade Thermometers. Min.	Earth Thermometers. 5 Inch.	Earth Thermometers. 10 Inch.	Grass Thermometers freely exposed. Max.	Grass Thermometers freely exposed. Min.	Wind. Direction.	Rain. Previous 24 Hours.	Remarks.
	Inches.	°	Inches.	°	°	°	°	°	°	°	°		Inches.	
1 Friday,	29·168	54	29·185	52·9	52·8	53·8	45·0	42·2	43·4	68·3	40·2	S.E.	·180	Cloudy, showery, sudden outbursts of
2 Saturday,	29·166	50	29·193	49·0	48·6	49·7	43·0	43·2	44·8	71·0	32·6	N.E.	1·670	Fine, breezy, occasional sun. [sunshine.
3 Sunday,	28·542	50	28·570	48·0	47·2	49·0	48·0	44·0	46·0	67·0	45·0	S.W.	·150	Breezy, light showers, changeable.
4 Monday,	28·450	48	28·489	47·0	46·2	47·6	46·1	44·2	45·8	62·2	39·0	S.W.	·020	Do.
5 Tuesday,	28·488	49	28·521	48·4	48·1	48·6	44·3	43·8	45·3	63·1	33·2	S.E.	·530	Cloudy, heavy rain, changeable.
6 Wednesday,	28·878	49	28·911	48·0	45·2	48·2	43·2	43·2	45·1	82·6	37·0	S.W.	·000	Fine, breezy, occasional sun.
7 Thursday,	29·170	47	29·208	46·2	45·2	46·9	40·0	43·0	44·6	66·2	30·0	N.W.	·000	Cloudy, overcast, and mild.
8 Friday,	29·764	44	29·808	43·0	42·0	43·5	32·0	40·8	43·6	84·2	27·2	S.W.	·000	Fine, occasional sun, slight frost.
9 Saturday,	30·120	47	30·155	46·8	45·8	46·9	37·3	40·8	42·6	90·0	31·0	W.	·000	Fine and calm, slight frost.
10 Sunday,	30·038	50	30·063	49·4	46·0	50·0	38·0	42·0	43·4	64·0	34·0	S.W.	·000	Fresh breeze, cloudy, occasional sun.
11 Monday,	29·904	53	29·925	52·0	50·0	52·2	45·0	43·0	44·0	73·2	35·0	S.W.	·120	Cloudy, mild, occasional sun.
12 Tuesday,	29·518	49	29·550	48·6	45·4	48·9	44·0	43·2	44·6	80·0	35·0	S.W.	·000	Strong breeze, showery, bright sun.
13 Wednesday,	29·514	50	29·540	49·0	46·4	49·6	34·0	44·3	46·0	76·0	27·2	S.W.	·440	Fresh breeze, cloudy, occasional sun.
14 Thursday,	29·736	47	29·773	46·0	44·6	46·4	41·0	41·4	43·2	85·0	38·0	S.W.	·000	Fresh breeze, showery, bright sun.
15 Friday,	29·646	46	29·683	45·2	43·0	45·8	26·2	38·6	41·0	91·0	20·4	S.E.	·170	Cloudy, heavy fog, sharp frost.
16 Saturday,	29·500	50	29·526	49·2	48·6	50·0	44·0	41·0	42·6	64·2	40·0	S.W.	·420	Fresh breeze, light showers, changeable.
17 Sunday,	29·500	50	29·526	49·4	48·0	50·0	44·0	42·0	43·8	63·0	36·4	S.E.	·240	Fresh breeze, light showers, occasional
18 Monday,	29·350	47	29·388	46·4	45·6	46·9	45·6	43·0	44·2	75·0	41·0	S.E.	·070	Cloudy, light showers, changeable. [sun.
19 Tuesday,	28·956	45	29·001	43·9	42·0	44·2	38·0	42·0	44·0	65·0	29·4	S.E.	·120	Do.
20 Wednesday,	28·642	44	28·687	43·0	42·2	43·6	42·6	41·0	43·0	61·0	37·0	S.E.	·160	Do.
21 Thursday,	28·862	39	28·923	38·0	37·0	38·8	37·0	39·8	42·0	64·0	33·0	N.E.	·210	Do.
22 Friday,	29·052	38	29·112	37·4	35·2	37·8	33·0	37·6	40·8	87·6	28·8	S.W.	·000	Fresh breeze, light showers, changeable.
23 Saturday,	29·248	41	29·303	39·0	36·4	40·4	32·0	36·0	39·0	88·4	26·0	S.W.	·000	Fresh breeze, sharp frost at night.
24 Sunday,	29·404	41	29·459	39·0	37·0	40·2	28·0	35·0	38·0	72·0	20·0	S.E.	·200	Cloudy, sharp frost at night.
25 Monday,	29·880	40	29·835	38·2	37·0	40·6	37·0	36·0	38·2	48·0	33·0	S.E.	·040	Stormy, hail and rain showers.
26 Tuesday,	29·982	41	30·037	39·0	38·0	40·2	37·0	36·0	38·0	51·0	31·0	S.E.	·500	Stormy, very cold and wet.
27 Wednesday,	29·330	46	29·368	45·2	45·0	45·8	38·0	38·0	40·6	51·0	35·0	S.E.	·070	Strong breeze, light showers.
28 Thursday,	29·396	53	29·418	51·0	48·2	52·0	43·0	41·2	42·4	70·0	36·4	S.W.	·000	Stormy, showery, occasional sun.
29 Friday,	29·416	47	29·454	47·6	46·4	47·2	40·0	41·0	42·2	86·0	33·4	S.E.	·360	Cloudy, heavy showers, changeable.
30 Saturday,	29·066	53	29·088	52·2	50·8	52·8	40·4	42·0	43·0	62·4	35·0	S.E.	·500	Breezy, showery, occasional sun.
31 Sunday,	28·788	51	28·816	49·8	48·2	50·4	47·0	43·0	44·2	74·2	41·0	S.W.	·040	Stormy, heavy showers, changeable.
													6·210	